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ON THE ALLEGED INCREASE OF CANCER.

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The statistical study of cancer as a cause of death, which is the subject of this paper, should not be confused with that of cancer as a disease. Whether the disease is increasing can be answered only by trustworthy morbidity statistics. As no country or city in the world has such statistics, no significant statistical study of cancer as a disease has been or can be written. Hence the present paper is concerned only with the alleged increase of cancer as a cause of death. But at the start it should be conceded that, strong as the argument is for the increase of cancer mortality, that for the increase of cancer morbidity is probably stronger, *i. e.*, the case fatality is probably less than formerly. This would follow from the increasing proportion of operations to cases, in some of which the disease never recurs, in others of which its progress is stayed, affording a longer interval for the occurrence of a death from some other cause. The same conclusion is supported by other improvements in methods of treating cancer, all tending to prolong the patient's life after the onset of the disease and to increase the chance of an intervening death from some other cause.

This paper, however, is concerned only with the question, Is cancer mortality increasing? In nearly all parts of the civilized world the reported mortality is increasing rapidly and this is the basis for the prevalent opinion that the real mortality is increasing. General statements about improvements in the diagnosis of cancer and the increasing proportion of

elderly persons especially liable to the disease warrant the opinion that the true increase is less than that shown by the figures, an opinion held by all students of the subject, even those who seem at times to accept the figures at their face value. But these general statements alone do not justify the denial of any increase and leave the problem as one inviting further investigation.

Studies in this field are of two main types, which may be distinguished as intensive and extensive. In the case of an intensive study the figures examined speak for only a limited area, usually a city, and are analyzed in various ways, in order to disentangle their true meaning and to confirm or correct one inference by another. In the case of an extensive study, the figures speak for many different districts, and reliance is placed upon the corroboration derived from similar indications in many or all.

Nearly all studies of the increase of cancer have been made by physicians who have done little work in statistics, but two careful examinations have been made by statists of high repute and are so much more thorough and significant than any of the others that they stand in a class by themselves. One, written by Messrs. King and Newsholme and published in 1893, is a model of an intensive investigation, mainly into evidence derived from the city of Frankfort in Germany.* The other, written by Mr. F. L. Hoffman and published in 1915, is the only example with which I am acquainted of an extensive investigation.† But two other international compilations of vital statistics, including statistics of cancer, have recently been published‡ and a large body of American material for the decade 1900–1909 and the year 1914 has been brought together.§ All these contain uninterpreted figures which can

* "On the Alleged Increase of Cancer," in Royal Society, *Proceedings*, liv, pp. 209–242. Read May 4, 1893. To be cited henceforth in this article as *King and Newsholme*. Republished in Institute of Actuaries, *Journal*, XXXVI, part II (July, 1901), pp. 120–150.

† *The Mortality from Cancer Throughout the World*, The Prudential Press, Newark, N. J., 1915. To be cited henceforth in this article as *Hoffman*.

‡ *Statistique Internationale du Mouvement de la Population*, in two volumes, Paris, Imprimerie Nationale, 1907 and 1913. To be cited henceforth in this article as *March*. *Statistique Démographique des Grandes Villes du Monde, 1880–1909*, in two parts. (Communications statistiques, Bureau municipal de Statistique d'Amsterdam, nos. 33 and 40.) Amsterdam, Johannes Müller, 1911 and 1912. To be cited henceforth in this article as *Falkenburg*.

§ United States Bureau of the Census, *Mortality Statistics, 1909*, Washington, 1912; and *Mortality from Cancer and Other Malignant Tumors in the Registration Area of the United States, 1914*, Washington, 1916.

be made to throw no little light upon the alleged increase of cancer mortality.

In view of this situation, the objects at which I aim are:

1. To review the intensive study of Messrs. King and Newsholme and to present new evidence from Frankfort for the period 1890–1913 by which their argument may be tested.

2. To summarize the results of other intensive studies which have been published since 1893.

3. To make a new extensive study by reviewing and interpreting the large body of evidence recently published in the international and American sources with no fuller interpretation than that found in Mr. Hoffman's volume.

Such a paper seems the more opportune for two reasons: first, because the two most significant studies reach diametrically opposite conclusions, King and Newsholme alleging that "the increase in cancer is only apparent and not real,"* and Hoffman maintaining "that the mortality from cancer is increasing at a more or less alarming rate throughout the entire civilized world"†; and secondly, because little, if any, attention has hitherto been given to the light thrown on this problem by recent international compilations.

The competent statistical study of this question began in 1893 with the paper by Messrs. King and Newsholme. Mr. George King, one author, was Secretary of the Institute of Actuaries and Dr. Arthur Newsholme, the other, was the author of the standard English treatise on vital statistics. This article, written in coöperation by men both adequately equipped in statistics and one equipped in medicine, is probably the most significant statistical discussion of the problem which appeared before 1915 and therefore I shall begin with an examination of its arguments in the light of the additional evidence made available since it was written.

To prove that there is no increase in cancer mortality, all of the apparent increase must be explained by an appeal to other causes. Messrs. King and Newsholme were the first students of the problem who trod this difficult road and they have not found imitators. It is in the choice of a method rather than in

* *King and Newsholme*, p. 228.
† *Hoffman*, p. 218.

the conclusiveness of the results that the main value of their paper lies.

Their main conclusion and the one with which we are primarily concerned was that "the increase in cancer is only apparent and not real." Their argument shows that this statement refers only to cancer mortality and is in no wise inconsistent with an increase of cancer morbidity offset by a diminishing case fatality.

Their subsidiary conclusions supporting this main conclusion were two:

1. A part of the increase in the crude cancer mortality is due to the increasing average age of the population and is eliminated when standardized death rates are computed.

2. In Frankfort-on-the-Main, the only population group in which the annual budget of deaths from cancer at each age and for each sex had long been carefully classified by the organs or parts of the body primarily affected, "the increase in cancer is only apparent and not real and is due to improvement in diagnosis and more careful certification of the causes of death. This is shown by the fact that the whole of the increase has taken place in inaccessible cancer difficult of diagnosis, while accessible cancer easily diagnosed has remained practically stationary."*

This argument was apparently regarded by the authors as decisive and upon it they rested their case.

The second of these two main arguments was supported by two minor arguments, which may first be reviewed in the light of the new evidence.

1. The increase of cancer mortality between 1860 and 1891 among men insured in the Scottish Widows' Fund Life Assurance Society, the only group of insured persons for which the requisite information could be obtained, was much less rapid than its increase in the general population of Scotland. This difference was explained by supposing that, when the figures began, the diagnosis of cancer among insured persons was more accurate and among them, in consequence, the effect of improvement of diagnosis during the thirty years was less than in the general population.

* *King and Newsholme*, p. 228.

2. Cancer mortality was lower but increased faster among men than among women. This was ascribed to the greater proportion of cases of inaccessible cancer among men, the greater obstacles to accurate diagnosis in such cases, and the more rapid improvement in the diagnosis of inaccessible cancer.

Their argument from insurance experience is illustrated by the following figures compiled from those in their article.

DEATH RATE FROM CANCER PER 100,000 MALES AT LEAST TWENTY-FIVE YEARS OF AGE, DISTRIBUTED IN AGE GROUPS AS IN ENGLISH LIFE TABLE NO. 3.

Period.	Insured in Scottish Widows' Fund Life Assurance Society.	In Total Population of Scotland.
1860–1866	60	70
1867–1873	83	82
1874–1880	75	101
1881–1887	85	115

The increase of the death rate among the general male population was 45 per 100,000, or 64 per cent., that among the insured males was 25 per 100,000, or 42 per cent. Mr. Hoffman quotes some additional evidence furnished by the medical officer of the same Society,* the figures of which, it will be noted, do not agree entirely with those published by Messrs. King and Newsholme. I learn from the actuary of one of the largest American insurance companies that probably no evidence on this point has been published by any American company. But even if it were buttressed by much additional material, I cannot attach great weight to this argument, because of the uncertain influence of selection in any class of insured persons. During the thirty years covered by the experience of the Scottish insurance company, for example, it may have extended its business among classes somewhat less subject to cancer than its earlier policy holders or the protective influence of the company's medical selection may have diminished.

The second argument advanced by Messrs. King and Newsholme is based upon the lower rate and more rapid increase in the cancer mortality of men. Among males cancer usually

* *Hoffman*, pp. 84, ff.

attacks an inaccessible organ or part of the body and for that reason is difficult to diagnose correctly even at the time of death, a difficulty which has decreased with the improvements of modern medicine and surgery. Thus, accepting as correct their classification of deaths from cancer in Frankfort into the two groups of accessible and inaccessible, 97 per cent. of the male deaths and only 63 per cent. of the female deaths ascribed to such cancers occurred where the seat of the disease was inaccessible.* Their argument is illustrated by the following figures computed from those in their paper.

DEATH RATE FROM CANCER PER 100,000 PERSONS OF SEX INDICATED AND AT LEAST TWENTY-FIVE YEARS OF AGE DISTRIBUTED IN AGE GROUPS AS IN ENGLISH LIFE TABLE NO. 3.

Country.	1860.	1890.	Increase.	
			Amount.	Per Cent.
Males.				
England	59	145	86	146
Scotland	67	174	107	160
Ireland	59	92	33	56
Females.				
England	119	210	91	77
Scotland	116	220	104	90
Ireland	72	111	39	54

The foregoing figures show that in all these divisions the female rates at both dates were much higher, that in England and Scotland the actual increase for the two sexes is about the same and the relative increase for men much greater, but that in Ireland the same facts do not appear. What do the recently published compilations show about the comparative increase of cancer in the two sexes? *Hoffman* alone gives death rates by sex. These he gives for each of the New England states, for Massachusetts since 1856, for Rhode Island since 1871, for Connecticut since 1879, for New Hampshire since 1887, for Maine since 1892, and for Vermont,

* The data involved will be found in the Appendix, Table VIII.

1871–1896. In 2 of these states the absolute increase and in 4 the relative increase of cancer mortality was greater among men than among women. A summary of his figures for the first 5 states since 1896 by sex yields the following results:*

Period.	Death Rate per 100,000 Population.		Increase.				Ratio of Male Rate to Female (=100).
			Amount.		Rate.		
	Male.	Female.	Male.	Female.	Male.	Female.	
1896–1900	46.2	90.3					51.2
1901–1905	53.6	100.9	7.4	10.6	16.0	11.7	53.1
1906–1910	61.5	110.9	7.9	10.0	14.7	9.9	55.5

These figures show that the rate of increase in cancer mortality among men has been somewhat more rapid than among women and that during the period the ratio of male mortality to female increased 4.3 per cent.

For the Federal registration area as constituted in 1900† the cancer death rates by sex were:

Year.	Death Rate per 100,000 Population.		Increase.				Ratio of Male Rate to Female (=100).
			Amount.		Rate.		
	Male.	Female.	Male.	Female.	Male.	Female.	
1900	47.0	80.7					58.2
1915	72.3	111.9	25.3	31.2	53.8	38.7	64.6

indicating that among men the increase was less, but the rate of increase greater, than among women. The ratio of male mortality to female increased 6.4 per cent. in fifteen years.

Among the 26 American cities for which Mr. Hoffman gives death rates by sex there are 10 in which the absolute increase and 19 in which the relative increase of the cancer mortality

* For the figures on which these rates are based see Appendix, Table I.

† Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, District of Columbia, Michigan, and Indiana. See Appendix, Table II. For our problem the figures of "the registration area" are without value, because of that area's rapid expansion since 1900.

is greater among men. The figures by sex since 1891 are given for 14 American cities.* They yield the following summary:

Period.	Death Rate per 100,000 Population.		Increase.				Ratio of Male Rate to Female (=100).
			Amount.		Rate.		
	Male.	Female.	Male.	Female.	Male.	Female.	
1891–1895	39.4	71.9					54.9
1896–1900	45.8	77.7	6.3	5.8	15.9	8.1	59.0
1901–1905	52.1	85.8	6.4	8.1	14.0	10.4	60.8
1906–1910	61.8	95.5	9.7	9.7	18.7	11.3	64.7

Thus, the cancer mortality of men in American cities has increased faster than that of women and the change has gone on more rapidly than in the American states. In fifteen years the ratio of male mortality to female has increased 9.8 per cent.

Among the 30 foreign countries for which Mr. Hoffman gives death rates by sex, there are 12 in which the absolute increase and 20 in which the relative increase of cancer mortality is greater among men than women and in the minority of 10 are 5 small Australasian divisions. He gives the figures by sex since 1895 for England and Wales, Ireland, Norway, Bavaria, Italy, New South Wales, Victoria, South Australia, Queensland, Tasmania, New Zealand, Bermuda, and Jamaica. By combining the results the following summary has been obtained.†

Period.	Death Rate per 100,000 Population.		Increase.				Ratio of Male Rate to Female (=100).
			Amount.		Rate.		
	Male.	Female.	Male.	Female.	Male.	Female.	
1896–1900	57.2	76.9					74.4
1901–1905	63.8	82.3	6.6	5.4	11.5	7.0	77.5
1906–1910	72.2	89.4	8.4	7.1	13.2	8.6	80.8

* Boston, Springfield (Mass.), Providence, Hartford, New Haven, New York, Philadelphia, Washington, Richmond, Augusta, Cleveland, Cincinnati, St. Louis, and Nashville. Appendix, Table III.

† Appendix, Table IV.

In this case the tendency of the male rate to overtake the female is more clearly marked, for the amount as well as the rate of increase is greater among the men. The ratio of male mortality to female increased 6.4 per cent. As each rate in the table is based upon more than 100,000 deaths from cancer, the steady decrease in the difference between the sexes is of more importance for the argument than that shown in the preceding tables.

Among the 33 foreign cities for which Mr. Hoffman gives the mortality by sex there are 24 in which the absolute increase and 26 in which the relative increase of the cancer death rate is greater among men. The figures by sex since 1896, given for 13 foreign cities separately and the cities of Denmark collectively, yield the following summary.*

Period.	Death Rate per 100,000 Population.		Increase.				Ratio of Male Rate to Female (=100).
			Amount.		Rate.		
	Male.	Female.	Male.	Female.	Male.	Female.	
1896–1900	80.4	107.6					74.7
1901–1905	90.3	115.0	9.9	7.4	12.3	6.9	78.5
1906–1910	99.4	120.1	9.1	5.1	10.1	4.4	82.8

The ratio of male mortality to female has increased 8.1 per cent.

All the new evidence supports the conclusion of Messrs. King and Newsholme that the death rates from cancer in the two sexes are approaching equality as a result of the more rapid increase among men.

Having reviewed the new evidence in these two subsidiary arguments, we turn now to the second of the main arguments advanced by Messrs. King and Newsholme, an argument supported by this difference between the cancer mortality of the two sexes. This alleges that the increase in cancer mortality is confined to mortality from inaccessible cancer. Their evidence on this point is derived from the figures of Frankfort-on-the-Main. They seem to have accepted the Frank-

* Appendix, Table V.

fort returns without any attempt to investigate the accuracy of the classification according to the part of the body affected by a study on the ground both of the original material and of the methods of treating it, a precaution which might well have been taken when so much depended on its accuracy. The able statists of Frankfort probably did not attach to this classification as much weight as the English interpreters. Certainly they abandoned it in 1891 and the Frankfort director, in a letter to me on the subject, volunteers the statement that in the opinion of German statists the diagnosis of cancer is not entirely trustworthy and that physicians out of regard for the family sometimes certify a death really due to cancer to be due to some less distasteful cause, like tumor.

Notwithstanding these reasons for giving less weight than our authors do to the Frankfort figures, it seemed wise to bring them down to date, if possible,—the more so, because in the 24 years since their article was published little new evidence has appeared based on a classification of deaths from cancer as located in accessible or inaccessible parts of the body. It was found, as mentioned above, that the Frankfort statistical office had abandoned the classification after 1891; consequently it was necessary to make a special tabulation of the figures since that date.* In order to insure comparability between the later and earlier figures, the returns for 1888 and 1889, which Messrs. King and Newsholme had compiled, were recompiled and their treatment of a few doubtful groups followed.

Some writers have objected to the classification of deaths from cancer according as the seat of the disease was accessible

* The needed sum was given by Dr. James Douglas at the suggestion of Prof. James Ewing, at whose request my paper was begun and who has aided me throughout its progress. Without his encouragement I should hardly have ventured so far into the field of medical statistics. I am greatly indebted to Director Busch of the Frankfort statistical office, who arranged to have his subordinates compile the data, and to Prof. R. M. Woodbury, then a travelling Fellow of Cornell University pursuing studies in economics and statistics at the University of Berlin, who went twice from there to Frankfort to explain exactly what was wanted and to review the results. His later services in Ithaca were also of much help in this part of the problem. The manuscript tables obtained from Frankfort have been deposited with the Library of the Surgeon-General's Office in Washington, where they may be examined by any persons desiring to test my inferences from them. The figures for 1860 to 1889, inclusive, are in *King and Newsholme;* those for 1890 are in the *Stat. Mittheilungen* of Frankfort for that year. But some of the certificates for 1890 and 1896 are now lacking and hence the returns for those two years have been disregarded. In Appendix, Tables VI–X, will be found all of Messrs. King and Newsholme's Frankfort material, each table supplemented by additional figures so as to add five new periods between 1888 and 1913.

or inaccessible, alleging either that a third class of intermediate cases should have been recognized or that certain organs or parts considered by Messrs. King and Newsholme as accessible should have been put in the inaccessible class or *vice versa*. In reply to the first objection, it is clear that the introduction of a third class of intermediate cases would obscure the argument. For our purposes a dual classification with a few border line groups thrown to one side or the other according to where most of the cases in the group belong is far better than the alternative triple classification. Whether their classification could have been improved is a question of technical medicine into which fortunately there is no need to go. My present object being merely to bring their material down to date, I would have to follow their classification, even if I knew, as I do not, that it had serious defects. But, in passing, I may mention that their decisions have found remarkable confirmation in the statistics of the Census Bureau's special bulletin on *Mortality from Cancer in 1914*, mentioned on p. 702, footnote §. Thousands of American doctors were asked to state, in connection with each cancer death certificate which they had filled out, whether the diagnosis was based on clinical findings, or confirmed by surgical operation or autopsy. With the help of their answers, the cancer deaths were classified under the captions "Diagnosis reasonably certain," and "Diagnosis uncertain." To this point I shall recur later (pp. 749, ff).

The new tables for Frankfort extend the original ones so that they embrace the fifty-four years, 1860–1913, instead of only the thirty years, 1860–1889, and nine thousand deaths instead of three thousand.* The final result is shown in the following table:

* Compare Appendix, Tables VI–X.

FRANKFORT. ANNUAL DEATHS FROM CANCER IN 1,000,000 LIVING, AT LEAST TWENTY-FIVE YEARS OF AGE. POPULATION DISTRIBUTED IN AGE GROUPS ACCORDING TO ENGLISH LIFE TABLE NO. 3.—PERSONS.(a)

Period.	Accessible.	Inaccessible.	Position Undefined.	Total.
		MALES.		
1860–1866	126	1,118	359	1,603
1867–1873	88	1,421	137	1,646
1874–1880	14	1,913	363	2,290
1881–1887	35	1,865	305	2,205
1888–1893(b)	91	2,289	171	2,551
1894–1899(c)	66	2,489	104	2,659
1900–1904	51	2,742	118	2,911
1905–1909	68	2,791	119	2,981
1910–1913	119	2,522	130	2,771
		FEMALES.		
1860–1866	1,081	1,323	293	2,697
1867–1873	1,214	1,540	254	3,008
1874–1880	1,220	1,588	131	2,939
1881–1887	981	1,820	272	3,073
1888–1893(b)	1,275	1,959	174	3,408
1894–1899(c)	903	1,936	122	2,961
1900–1904	914	2,013	115	3,042
1905–1909	925	2,311	180	3,416
1910–1913	913	2,057	152	3,122

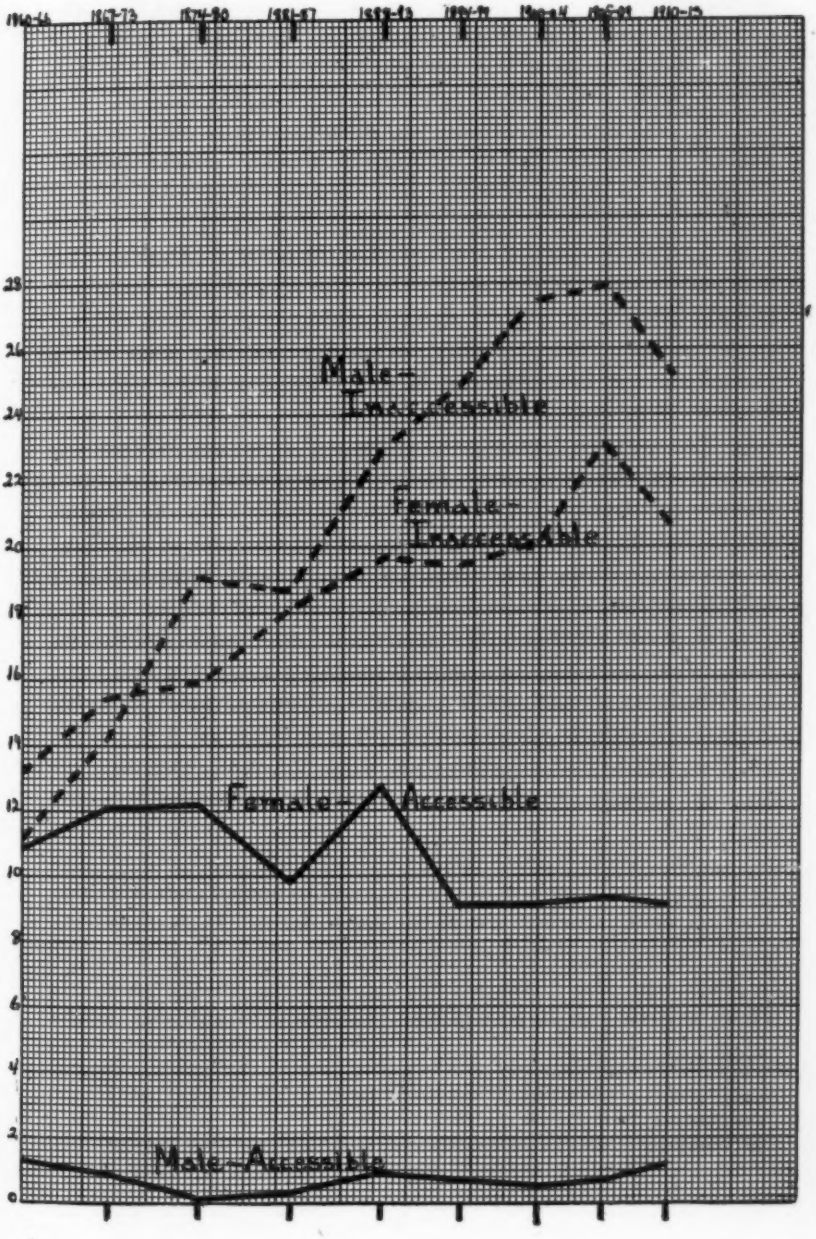
(a) Figures from 1860 to 1887, inclusive, derived from *King and Newsholme*, Table XVI. Figures for later years derived from manuscript tables from the Frankfort Statistical Office.
(b) Omitting the year 1890, for which the figures were not available.
(c) Omitting the year 1896, for which the figures were not available.

The general meaning of the table can be read more easily and clearly in the form of a diagram.* For the sake of simplicity the categories of "position undefined" for each sex and the total rates for each sex have been omitted and the diagram depicts, therefore, the conditions stated in the first two columns of the preceding table.

Both table and diagram show, each in its own way, that there has been no significant change in the small mortality from accessible cancer of men and there have been irregular changes followed by a remarkable uniformity in the mortality from accessible cancer of women. Almost all the increase occurred in the mortality from inaccessible cancer, although by a surprising exception that mortality in each sex decreased between the last two periods, while the mortality of men from

* See p. 713.

DIAGRAM I. DEATH RATES FROM CANCER, ACESSIBLE AND INACCESSIBLE, FRANKFORT-A-M.: 1860–1913.



accessible cancer increased. The argument of Messrs. King and Newsholme from the Frankfort figures is thus materially strengthened.

To this argument several objections have been made.

1. "It is quite doubtful whether all uterine or even vaginal cancer can be accurately diagnosed as such without an exploratory operation or a microscopical examination of the diseased parts."* The evidence in the Census Bureau's recent bulletin on cancer, to which reference has already been made (p. 711) leads to a different conclusion.

2. "A fair proportion of deaths from cancer are those of the skin, other parts of the mouth than the tongue, and other external parts of the body"† and these should have been classed as accessible. The objection overlooks the fact that these classes are not distinguished in the printed sources used by Messrs. King and Newsholme.

3. The authors "for reasons unknown" have not reëxamined the Frankfort data since 1893.‡ This overlooks the fact, already mentioned, that the method of publishing the Frankfort figures was radically changed at about the time the original article was published and serious difficulties put in the way of a reëxamination.

4. It is not clear whether correction was made for deaths from cancer among inmates of Frankfort hospitals who were non-residents of that city.§ Careful inquiry at the Frankfort registration office, supplemented by inspection of the manuscript returns, showed that they were not systematically excluded, but that the smallness of their number made them unimportant.

5. The classification of deaths in Frankfort "fails to conform to modern requirements in that it is not in accordance with the international classification of causes of death."‖ A classification is to be judged with reference to the object it was designed to serve and the character of the material to be classified. There is little reason to suppose that the international classi-

* *Hoffman*, p. 31.
† *Ibid.*
‡ *Ibid.*
§ *Ibid.*, footnote.
‖ *Hoffman*, p. 33.

fication is better adapted to the specific study of cancer death rates than another which may have had that object in view and certainly has been found valuable for it.

6. The results do not agree with those derived from the Frankfort data for 1906–1913 given in the official reports of the Frankfort Medical Society.* The latter are in conflict with those for the same years which I have derived from the official records of the Frankfort statistical bureau and already presented, and the differences appear irreconcilable. The figures of the Medical Society make no attempt at a classification into accessible and inaccessible and in consequence have little bearing upon the argument.

7. The standardized death rates from cancer in Frankfort, 1860–1889, by five periods of years show irregular changes, perhaps due to paucity of numbers, but they cannot be interpreted as affording no evidence of increase in the rates for accessible cases among women.† To this objection the supplementary figures already presented afford perhaps a sufficient reply.

These objections to the argument of Messrs. King and Newsholme do little to weaken its probative value. An objection of greater weight than these lies against their reliance upon standardized rates and will have to be considered later. In face of all the objections we can hardly accept their conclusion in the emphatic way in which it is stated. Neither the original argument nor my amplification of it, nearly doubling the period of observation and more than trebling the number of cases, can be held to justify completely their statement that "the increase in cancer is only apparent and not real and is due to improvement in diagnosis and more careful certification of the causes of death." The great merits of their paper lie in exemplifying the correct method of attacking the problem and showing beyond question that a measurable part of the increase in the mortality from cancer is due to a better diagnosis of the causes of death and another measurable part to the increasing proportion of persons who live on to ages when cancer is prevalent.

Let us now examine the first of their two main arguments,

* *Hoffman*, p. 31.

† Greenwood and Wood, "On Changes in the Recorded Mortality from Cancer and their Possible Interpretation," in *Proceedings of the Royal Society of Medicine*, VII, no. 1, pp. 119–70.

namely, that part of the increase is due to changes in the age and sex composition of the population and can be measured by the use of standardized death rates. No one will question that the increasing proportion of elderly persons in the population accounts for part of the increase in cancer mortality. But that this part can be measured by the help of standardized rates has been somewhat uncritically taken for granted in the United States and England. Various earlier writers had pointed out that cancer is preëminently a disease of adult and elderly life and that the proportion of the population at any moment living at ages when cancer is frequent is increasing with the lengthening of human life. But it was reserved for Messrs. King and Newsholme to put the argument into the necessary quantitative form. In computing standard death rates, they chose for the population a standard million based on English Life Table No. 3, Persons. To this they applied the cancer death rates for each sex and age group at each of two periods and compared the results. In such a computation the increase or decrease in the computed deaths is supposed to show by how much the cancer mortality would have increased or decreased, if there had been no change in the sex and age composition of the population but such changes as did occur in death rates.

This method of using standardized rates has long been followed in England, has recently been adopted in the United States, and is regarded by Messrs. King and Newsholme as a prime requisite to sound work in dealing with the present problem. They say: "In order to be useful, the materials . . . must be presented in such form that, at any rate for several intervals of years, the deaths from cancer and the population may be grouped according to sex and age"*; and it was because these conditions were satisfied nowhere but in the Frankfort statistics and those of the Scottish Widows' Fund Life Assurance Society that our authors relied so heavily upon that material. Their principle is a veritable bed of Procrustes. Its acceptance excluded at one stroke probably all other cancer statistics than those mentioned, and, if it is sound, the significant material is still so meager as to make an

*P. 212.

extensive study even now quite out of the question. Accordingly the principle should not be accepted without a more careful scrutiny than it has hitherto received. The method assumes that a standard population is needed but that it is a matter of indifference what standard is adopted. Thus Messrs. King and Newsholme say: "It is not of importance what standard is selected, because, all the observations being treated alike, the comparisons instituted between them will be entirely trustworthy."*

It is desirable to put this assertion to the test. The standards most likely to be in the mind of Englishmen writing in 1893 were the English Life Table No. 3 and the population of England in 1881, the date of the latest available census. A comparison of these two standards is made in Table XI of the Appendix and is expressed to the eye through the diagram on page 719.

The diagram shows clearly what the figures confirm and make precise, that the proportions actually living at the various ages in England in 1881 were very different from those shown by a life table. The life table assumes a population exempt from the disturbing factors of emigration and immigration and also from the distortion engendered by a rapidly increasing population, which swells inordinately the contingents belonging to the early years of life. Cancer is a cause of death almost unknown in infancy and childhood but common in adult and elderly years. Hence the standardized death rate from cancer obtained by using a standard in which adults and elderly persons are numerous must be much above the rate obtained by using a standard in which they are relatively few. For example, the standardized cancer mortality of Frankfort, 1860–1866, was 107 per 100,000, if the standard used is the English Life Table population, but only 70, or about two thirds as high, if the standard is the population of England and Wales in 1881.† To this objection it might be replied that the information needed is not the standardized rate in any single period but the increase between two periods and that the increase, absolute or relative, might be the same even though

* Pp. 211–12.

† See Appendix, Table XII.

the rates compared were widely different. But the answer is unsatisfactory for two reasons: first, if the absolute increases were the same, the relative or proportional increases could not be; and, secondly, as the increase in the cancer death rate as well as its amount varies greatly with age, the chances against the agreement of two increases reached by using two such divergent standards are indefinitely great. In the case in hand, if the life table population is the standard, the increase in the standardized death rate of Frankfort is from 107 per 100,000 in 1860–1866 to 167 per 100,000 in 1888–1889, which is 60 per 100,000, or 57 per cent.; but if the population of England in 1881 be the standard, the increase is from 70 in 1860–1866 to 107 in 1888–1889, which is 37 per 100,000, or 53 per cent.*

From this argument it might be inferred that the method of standardized death rates, if not generally invalid, is at least inapplicable to the present problem. But that would be going too far. In most civilized countries the average age of the population is slowly increasing, due in part to the fall in the death rate, especially in early years, and in part to the fall in the birth rate. For example, in the United States the median age of the population increased by 7.3 years between 1820 and 1910,† or about four fifths of a year in each decade; and similar, though less rapid, changes are probably occurring in many other countries. Wherever this change is in progress some part of the increase in cancer mortality is due to it. It is theoretically possible that the whole might be so explained. Under these circumstances either some estimate of the part due to that cause must be reached or our problem abandoned on the threshold. An escape from the dilemma may be found along the following path if the requisite data are available.

To the population of a given sex and age at the beginning of a period the corresponding cancer death rates at the end of the period are applied, the sum of the computed deaths being the number which would have occurred, had the composition of the population remained unchanged. From this sum a "corrected" death rate and the increase during the period due only to the changes in reported cancer mortality may be

* Appendix, Table XIII.

† United States Bureau of the Census, *Thirteenth Census*, vol. I, p. 309.

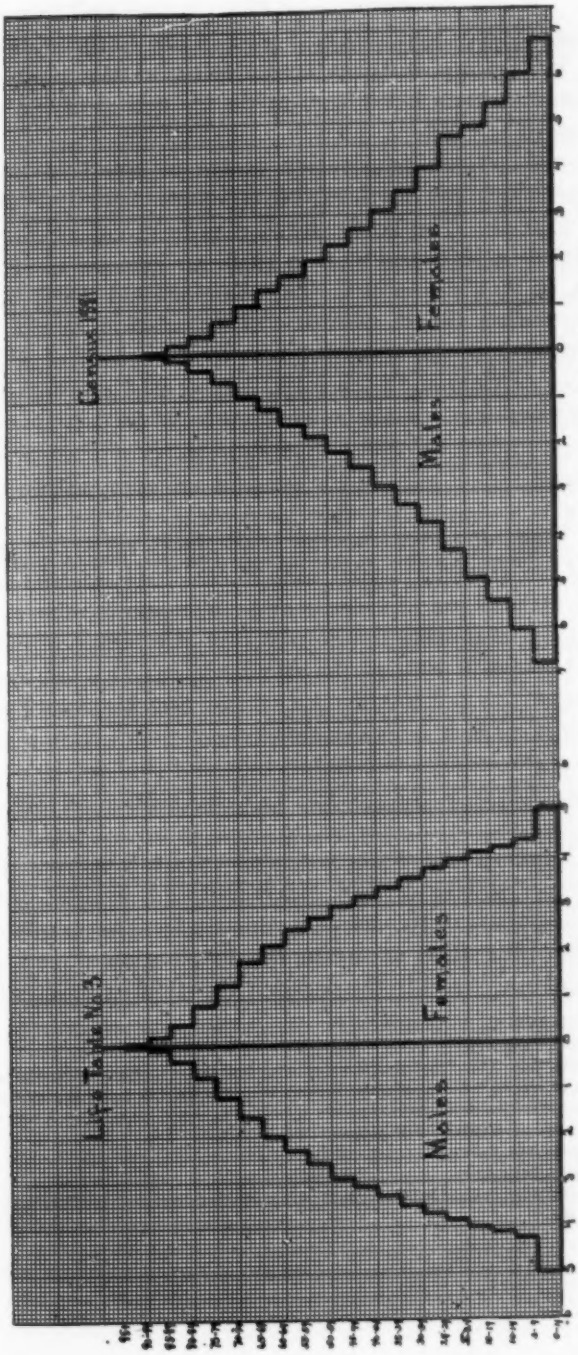


DIAGRAM II. STANDARD MILLION, ENGLISH LIFE TABLE NO. 3 AND ENGLAND AND WALES CENSUS OF 1891.

derived. A comparison between this increase and that in the crude rates shows how much, if any, of the latter is due to a change in the sex and age composition of the population. Such computations have been made for this study in a few cases chosen at random.

a. The American registration states of 1900* include all states for which the death rate from cancer both in 1900 and 1910 is known. The crude death rate from cancer was 63.9 per 100,000 in 1900 and 83.0 in 1910, an increase of 19.1 per 100,000, or 29.9 per cent.† The standardized death rate in 1910, accepting the distribution of population in the same states in 1900 as the standard, was 81.3, instead of 83.0, an increase over 1900 of 17.4 per 100,000, or 27.2 per cent.‡ As 27.2 is 91 per cent., or about nine tenths, of 29.9, it is evident that about one tenth of the increase in the crude rate was due to the decennial change in the sex and age composition of the population.

b. In England and Wales the crude death rate from cancer was 84.3 per 100,000 in 1901 and 99.3 in 1911, an increase of 15.0 per 100,000, or 17.8 per cent.§ The standardized death rate in 1911, accepting the distribution of population in England and Wales in 1901 as the standard, was 91.5, an increase over 1901 of 7.3 per 100,000, or 8.7 per cent.‖ As 8.7 is less than half of 17.8, it is evident that more than one half of the increase in the crude rate between 1901 and 1911 was due to the decennial change in the sex and age composition of the population.

c. In England and Wales the crude death rate from cancer was 58.9 per 100,000 in 1881–1890 and 75.8 in 1891–1900, a decennial increase of 16.9, or 28.7 per cent.¶ The standardized death rate, 1891–1900, accepting the distribution of population in England and Wales in the decade 1881–1890 as the standard,

* See p. 707, footnote †.

† See Appendix, Table XIV.

‡ See Appendix, Table XV. The method here used differs from that of the Bureau of the Census (*Mortality Statistics, 1911*, p. 33) in two respects: first, the standard population is not that of England and Wales in 1901, but that of the American registration states in 1900, and, secondly, the crude death rates used are those of the calendar years 1900 and 1910 instead of 1901 and 1911.

§ See *Hoffman*, p. 596, Table 6.

‖ See Appendix, Table XVI.

¶ Registrar-General of England and Wales, *Supp. to 65th Ann. Rep.*, pt. I, p. xxviii; *Supp. to 65th Ann. Rep.*, pt. I, p. xcix.

was 74.8 per 100,000, an increase of 15.9 per 100,000, or 27.0 per cent.* As 27.0 is about fifteen sixteenths of 28.7, it is evident that about one sixteenth of the increase in England's crude death rate from cancer in the decade 1891–1900 as compared with the decade 1881–1890 was due to the decennial change in the composition of the population.

d. In New York City the crude death rate from cancer was 65.5 per 100,000 in 1900 and 78.0 in 1910, an increase of 12.5 per 100,000, or 19.1 per cent.† The standardized death rate in 1910, accepting the distribution of population in New York City in 1900 as the standard, was 76.6, an increase of 11.1 per 100,000, or 16.9 per cent.‡ As 16.9 is about eight ninths of 19.1, it is evident that about one ninth of the increase in the crude death rate of New York City between 1900 and 1910 was due to the change in the composition of the population.

e. In London the crude death rate from cancer was 93.7 per 100,000 in 1901 and 107.2 in 1911, an increase of 13.5 per 100,000, or 14.4 per cent.§ The standardized death rate in 1911, accepting the distribution of population in London in 1901 as the standard, was 95.5, an increase of 1.6 per 100,000, or 1.7 per cent.|| As 1.7 is less than one eighth of 14.4, it is evident that more than seventh eighths of the increase in the crude death rate of London between 1901 and 1911 was due to the change in the composition of the population between those dates.

The general result of these calculations is to show that a considerable part of the increase in the crude death rate from cancer, a part ranging in these five cases from 5 to 88 per cent. and averaging about one third, is due to changes in the sex and age composition of the population. From the evidence I conclude that on the average not less than one tenth of the apparent increase¶ may be thus explained and that, wherever the birth rate as well as the death rate has been falling over a

* See Appendix, Table XVII.

† See United States Census Bureau, *Mortality Statistics, 1909*, p. 156, and *1910*, p. 103.

‡ See Appendix, Table XVIII.

§ *Hoffman*, p. 605, Table XVI.

|| See Appendix, Table XIX.

¶ I select this fraction somewhat arbitrarily because it comes near the result for the American registration states and the smaller of the two results for England. Results for a great country are likely to be nearer the average than those for any city, however populous.

period of years and in consequence the proportion of adult and aged persons in the population has been rapidly rising, there the change in the sex and age composition of the population may explain a much larger part of the increase in the crude death rate from cancer.

The article of Messrs. King and Newsholme, then, is faulty at a point where it has not hitherto been criticized, its unhesitating reliance upon standardized death rates of the usual type and its rejection of all material which does not lend itself to that method. It is valuable because of its emphasis upon the influence of improved diagnosis as a factor and even more significant because it pointed out that other causes competent to produce the result must be detected and measured by whoever denies that any part of the apparent increase of cancer is real.

Since their article was published a few other intensive studies have appeared, although none, I believe, indicates so firm a mastery of the method to be pursued and none carries out so thoroughly the distinction between accessible and inaccessible cases. The results of these may now be briefly summarized.

Massachusetts (1850–1895). In his first study Dr. Whitney concluded that "The increase is probably due to better diagnosis and registration and until the ratio of deaths over 30 years [sc. to all deaths at that period of life] has reached 8 to 9 per cent., which is shown by autopsies to be the true rate for cancer, it is not justifiable to speak of the increase as inherent in the disease itself."* But in a later article he admitted the existence of "a steady increase in the deaths [sc. death rates?] from cancer which cannot be explained by improved registration and more careful diagnosis."†

District of Columbia (1881-1900). Dr. Smith accepts the views of Messrs. King and Newsholme and believes that the evidence does not demonstrate any increase in the true death rate from cancer.‡

Providence, R. I. (1856–1905). Dr. Chapin thinks it prob-

* Wm. F. Whitney, "Alleged Increase of Cancer in Massachusetts," Shattuck Lecture before Massachusetts Medical Society, June 11, 1901, p. 20.

† "Statistics of Cancer in Massachusetts," in *Boston Med. and Surg. Journ., CLXII* (May 19, 1910), p. 673.

‡ C. A. Smith, "District of Columbia Cancer Record," in *Am. Med., III* (1902), pp. 916–19.

able, "that there has been no real increase in those forms of cancer which are visible or the diagnosis of which is easily made," namely, cancer of the breast and cancer of the uterus; and that "the apparent great increase in the mortality from cancer is due to improved diagnosis and changes in the sex and age distribution of the population."*

Breslau (*1876–1900*). Dr. Frief showed that the death rate from cancer of the breast and uterus had been stationary and the whole increase was due to an increase in cancer of the abdomen. He concluded that, when the needed precautions had been taken and the needed corrections made, no regular and decided increase in the death rate from cancer was demonstrable.†

Utrecht (*1872–1902*). Dr. Astro showed that the death rate from those forms of cancer which were easily diagnosed fell to three fourths of the initial rate, while the death rate from cancer of other forms more than doubled.‡

Amsterdam (*1862–1902*). Dr. Van Konijnenburg concluded that it was impossible to decide with confidence how much of the increase in the recorded death rate from cancer was due to a real increase and how much to improved diagnosis.§

Paris (*1886–1905*). Dr. Bertillon showed that, during these 20 years, the death rate from cancer of the mouth, breast, and female generative organs hardly increased at all, but that from cancer of the stomach increased rapidly and that from cancer of the intestines more rapidly. In other words, the increase in the recorded death rate was practically confined to cases of inaccessible cancer.‖

Netherlands (*1867–1909*). Director Methorst was unable to determine whether the increase of cancer was due to a greater prevalence of the disease or to greater accuracy in its diagnosis, the latter influence certainly accounting for a part of the increase.¶

* *City Registrar's Report, 1905*, pp. 89–93.

† *Klinisches Jahrbuch, XII* (1904), p. 154.

‡ Quoted in Van Konijnenburg, *Mortalité par Cancer à Amsterdam, 1862–1902*, pp. 14 and 11. Müller, Amsterdam, 1911.

§ *Ibid.*

‖ *Annuaire Statistique de la Ville de Paris*, XXV (1904), p. 202.

¶ International Statistical Institute, *Bulletin*, XIX, pt. III, pp. 310–312.

England and Wales. Dr. Stevenson in a careful and illuminating study of English cancer death rates,* published in 1913, reached no conclusion upon the main question. In the following year Major Greenwood, Jr., and Frances Wood, discussing Dr. Stevenson's evidence and arguments, reached the general conclusion "that there is some truth in the popular opinion that the real incidence of cancer has increased."†

Both of these English papers and no little current discussion seem to favor the view that the general question with which this article is concerned, Is the mortality from cancer increasing? can best be attacked by breaking it up into a series of subordinate questions like, Is cancer of the breast increasing? and answering the former only by finding the resultant of various and probably conflicting currents of change in cancer of various parts or organs. I cannot but feel that this is postponing attack upon the simpler statistical problem until a series of more difficult ones are solved. In other words, however unsatisfactory the present discrimination and reporting of cancer as a cause of death may be, and I believe them, as a rule, to be very unsatisfactory, they are probably much more accurate and trustworthy than the reporting of the organ or part of the body primarily affected by the disease.

These are all the significant intensive studies of the increase of cancer which have come to my attention.

An incidental result of rejecting as I do the method of standardized rates as the only or main method, is that it opens the door for that extensive study of the material in the recent international compilations to which we now turn our attention.

When inquiring how far, if at all, improvements in the diagnosis of cancer account for the increase in reported cancer mortality, we should recall the four ways in which statements of the cause on certificates of death may be obtained:‡ (1) from a medical examiner, authorized and required to perform an autopsy whenever necessary for confirming the diagnosis; (2) from an officer required to examine the body and consult with the attending physician but not authorized to perform

* *74th Annual Report of the Registrar-General*, for 1911.

† Royal Society of Medicine, *Proceedings*, VII, no. 1, pp. 119–170.

‡ *Cf.* von Mayr, *Statistik und Gesellschaftslehre*, II, §75 (Die Todesursachen), pp. 309–329; and Prinzing, *Medizinisches Statistik*, pt. 3, chap. 6. (Die Todesursachen), pp. 318–406.

an autopsy; (3) from the attending physician, midwife, next of kin, coroner, or person best informed; (4) from whoever reports the death to the registration officer.

When the figures are to be used for such a purpose as ours the fourth method is valueless. The first method would be most accurate but is nowhere in use at present. As the frequency of autopsies is connected with the increasing number and size of cities and with the development of hospital facilities,* this method may come into general use in the remote future. At present accuracy in the statement of the cause of death may be expected only for cities and countries in which the cause is regularly certified by a medical examiner or attending physician and even in such cases it depends upon the ability of the physician to diagnose and his willingness to certify cancer as a cause.

Cancer is seldom reported by a layman as a cause of death.† Hence the proportion of deaths ascribed to that disease usually depends upon the proportion of physicians to population and more especially upon the proportion of deaths reported by physicians to all deaths. Have these proportions been increasing?

The following figures‡ show that the proportion of physicians in Germany has increased:

Date.	Number of Physicians to 100,000 Population in Germany.
1876	32
1887	33
1898	44
1904	54

That a similar change was in progress in England and Wales down to 1901 appears from the following figures:

Date.	Number of Physicians to 100,000 Population in England and Wales.
1881	58
1891	66
1901	70
1911	65

* In 15 large cities of Switzerland 26 per cent. of the deaths in 1900 and in the city of Basel 34 per cent. of the deaths in 1902 were followed by autopsies. Of the autopsies in Basel 86 per cent. occurred in hospitals and only 14 per cent. outside. *Cf.* Prinsing, *op. cit.*, p. 320.

† *Cf.* pp. 740, *f.*

‡ Prinsing, *op. cit.*, p. 541.

There is no trend in the United States similar to that in England and Germany.

Date.	Number of Physicians to 100,000 Population in the United States.
1880	171
1890	166
1900	174
1910	164

The proportion of physicians to population in this country is about three times as great as in Germany and more than twice as great as in England, but is not increasing. Probably much of the difference is due to differences in the method of enumeration and to the readiness with which American enumerators accept without verification the claims of persons of questionable standing to be physicians. No doubt the quality, if not the relative number, of American physicians has improved within a generation and as a result their ability to diagnose cancer by clinical means, while still far from adequate, is probably greater than it was in 1880.

About the proportion of deaths in which the cause is certified by a physician, we have no satisfactory information for the United States or any part of it. But even if it has not increased during the last generation, the rise in the level of the profession—a change which occurred earlier in some European countries—has led to a similar result, for the incompetent physician is less likely than the well-trained one to certify cancer as a cause of death.

In several foreign countries, however, it is known that the proportion of deaths certified by physicians has increased of recent years In Saxony in 1873 only 37 per cent. but in 1906, 66 per cent. of the deaths were reported with a physician's statement giving the cause.* In Bavaria the proportion of decedents whose deaths were medically certified rose from 45 per cent. for the years 1845–1850 to 65 per cent. for the years 1901–1902. In Würtemberg it rose from 47 per cent. for

* Georg Radestock, "Zur Statistik der ärtzlichen Beglaubigung von Todesursachen," in *Zeitschrift des k. Sächsischen Statistischen Landesamtes*, LIV (1908), Pt. I, pp. 133–139.

1876–1881 to 63 per cent. for 1899–1900; in Baden, from 52 per cent. for 1852–1859 to 70 per cent. for 1892–1901. In Switzerland the statistics of causes of death are perhaps better organized than anywhere else. Dr. Prinzing awards it this preëminence among the European countries.* Particularly important for our purposes are the provisions in Switzerland whereby the attending physician makes a confidential report upon the cause of death to the statistical bureau and issues another certificate as a prerequisite to the burial. It may be more than a coincidence that the death rate from cancer in Switzerland is much higher than in any other country, but has not increased since 1900.† Both of these facts it would be easy to harmonize with the theory that the reported death rate from cancer depends largely upon the accuracy of certification and its increase upon the improvement of certification. The proportion of medically certified deaths in Switzerland increased from 82 per cent. in 1876–1880 to 96 per cent. in 1901–1903. In these 5 countries as a group, and they are the only ones for which I have found the information, the ratio of deaths medically certified to all deaths has increased about 0.5 per cent. yearly.

The probability that a physician was in attendance upon a decedent varies with the economic value of the endangered life and that depends not merely upon the wealth or position of the family but also upon the age of the individual Thus in Saxony in 1905 among children under 1 year of age less than 2 deaths in 5 were medically certified, but at ages 20–29 about 15 in 16 were so certified. With advancing age the proportion sank rapidly: at 50–59 it was 91 per cent.; at 60–69 it was 86 per cent.; at 70–79 it was 71 per cent.; and at ages above 80 it was 55 per cent.‡ Similar variations with age are found in the figures for Würtemberg.§

The death rate from cancer steadily increases with age until near the end of life.|| There is a large proportion of persons

* *Op. cit.*, pp. 321 and 325.

† Appendix, Table XX, and *Hoffman*, p. 674.

‡ Radestock, *op. cit.*, p. 137.

§ Prinzing, *op. cit.*, p. 322.

|| The highest death rate almost always occurs at some age period above 70. See Appendix, Tables XII, XIII, XV, XVI, XVII, XVIII, and XIX.

dying at an advanced age without a physician's care. Probably this proportion is decreasing with the progress of the years, accompanying the decrease in the proportion at all ages already demonstrated and the improved economic position of the poor. These facts together furnish good ground for believing that a steady and important shift in the certification of deaths from an indefinite cause, like old age, to cancer has been in progress and that this has been closely dependent upon a change in the authority stating the cause of death at high ages, *i. e.*, from layman to physician. The deaths in Saxony in 1905 were classified according to the cause assigned and the proportion under each cause which received medical certification was stated. At the top of the list was cancer, a cause certified by physicians in 97 per cent. of the cases, and near the bottom of the list was old age, a cause certified by physicians in only 42 per cent. of the cases. Hence the spread of medical certification would necessarily result in the appearance under cancer of not a few deaths which, under earlier conditions, would have been certified by a layman as due to old age.

Influences contributing to the same result are the extension of hospital facilities and the increase in the proportion of autopsies. It is difficult to get figures about either. The importance of autopsy in diagnosing cancer is illustrated by Riechelmann's statement that in 1895–1901 a municipal hospital in Berlin had 711 cases of cancer established by autopsy, 156 of which, or 22 per cent., had not been so diagnosed during the lifetime of the patient, although the diagnosis had been made with the greatest care by the highest authorities, thus excluding the carelessness with which the ordinary physician in Berlin still reported the causes of deaths occurring in his practice.*

To be sure, not all the mistakes are on the same side. Sometimes a clinical diagnosis of cancer is negatived by the findings at the autopsy. But the additions resulting from autopsy exceed the subtractions. This is indicated by Dr. Bashford's evidence. In 1909 he reported upon 9,488 fatal cases in hospitals which had been treated during the life of the patient as

*W. Riechelmann, "Eine Krebsstatistik vom pathologisch-anatomischen Standpunkt," in *Berliner Klinische Wochenschrift*, XXXIX (August 4, 1902), p. 729.

cancer and after death had been checked by autopsies. This check showed that 757 cases, or 8.0 per cent., of those so diagnosed were not cancer. But during the same period and in the same hospitals, 1,801 other cases of fatal disease, more than twice as many, which during life had not been diagnosed as cancer were shown by autopsies to be so. The net result was to show that the true number of deaths from cancer in these hospitals was 10,532 instead of 9,488, so that the number diagnosed as cancer, rightly or wrongly, by clinical means during the lifetime of the patient was only 90 per cent. of the deaths actually due to this disease. In cases of cancer attacking accessible parts of the body the number of deaths determined by clinical examination was 98 per cent. of the true number; but where inaccessible parts of the body were primarily involved the number of deaths determined by clinical examination was only 68 per cent. of the true number.*

Dr. Williams has suggested that "these were specially selected lots of difficult hospital cases and cannot be regarded as in any way typical of every day experience."† That is a question upon which a layman must speak with diffidence, but in my opinion the greater attention and skill bestowed upon hospital patients would more than offset the greater difficulty of diagnosis, if it exists.

If physicians attending hospital patients often fail to diagnose cancer, such failures must be far more common among physicians in general practice, in which case an increase in the ratio of deaths in hospitals to all deaths would mean an increase in the ratio of deaths ascribed to cancer to all deaths from it. This suggests the question, Is the ratio of deaths in hospitals to all deaths increasing? The only evidence for the United States is indirect. At the end of 1904, to every 100,000 people there were 87 patients in American public hospitals; at the end of 1910 there were 118, an increase of more than one third in 6 years. During the year 1904, the number of patients treated in public hospitals was 1,309 per 100,000; during the year 1910, it was 2,124, an increase of nearly two thirds in 6 years.‡

* *Lancet*, 1909, II (Sept. 4), p. 694.

† W. R. Williams, *The Natural History of Cancer*, p. 54.

‡ United States Census Bureau, *Benevolent Institutions, 1904*, p. 32; *Benevolent Institutions, 1910*, pp. 48–49.

In Greater New York the proportion of deaths in hospitals to total deaths has doubled in the 17 years since the enlarged city was organized, rising from 16.3 per cent. in 1898 to 32.9 per cent. in 1915. In old New York the same change was in progress through an earlier period, the proportion of deaths in hospitals to all deaths rising from 15.4 per cent. in 1889 to 22.0 per cent. in 1897.*

German figures giving the number of beds in general hospitals, public and private, indicate a change almost as rapid. In that Empire in 1877 there were 166 hospital beds to 100,000 people and in 1910 there were 400, nearly two and one half times the earlier ratio.†

The figures for Austria‡ point to a slower increase. Owing to differences in the classification of hospitals in the two countries, the following ratios are not comparable with those for Germany.

Year.	Hospital Beds per 100,000 Population.
1870	118
1880	124
1890	142
1900	179

In France the average annual number of beds in hospitals in the periods 1871–1880 and 1901–1905§ may be compared with the population in the middle of each period. The results show an increase in beds per 100,000 people from 193 to 236 in about 30 years. Probably a similar change is under way in nearly every civilized country and there is little doubt that it has materially increased the chance of correctly diagnosing cancer as a cause of death.

The preceding evidence shows that in every European country for which the information was available the proportion of physicians to population and the proportion of deaths certified by physicians have increased; that in the United

* See Appendix, Tables XXI and XXII.

† See Appendix, Table XXIII.

‡ Prinzing, *op. cit.*, p. 545.

§ From *Stat. annuelle des Institt. d'Assistance* (1906), cited in Webb, *New Dict. of Statistics*, 1911, p. 298.

States, although neither is known to have risen, the average competence of physicians has probably increased; that in several European countries even now a large proportion of deaths at ages when cancer mortality is highest are not medically certified; that cancer is the cause of death least often stated by a layman; and that hospital facilities are more numerous and autopsies more frequent than ever before. With this evidence in mind, we are in a better position to weigh the arguments tending to show that improvements in the diagnosis and certification of cancer, which have long been in progress and are still continuing, explain at least in large part the increase in its reported mortality.

Let us assume for a moment the extremely skeptical position that the entire increase in the reported death rate, aside from that part due to increasing longevity, is due to improved diagnosis; or that the only influence affecting the death rate from cancer which has been statistically demonstrated is age. In other words, assume that there are no demonstrated differences in the true cancer death rate of men and women, of white and colored, of residents in city and country or in different countries, but that all differences in the recorded rates of these groups at the same age are due to differences in the accuracy of diagnosis. From this assumption certain corollaries would follow. If they are shown to conform to the facts, the assumption is thereby and to that degree made probable.

1. Is the proportion of deaths reported as due to an unknown or ill-defined cause decreasing? In the part of the United States for which significant figures exist, the registration states of 1900, the number of deaths ascribed to ill-defined or unknown causes* since 1900 has been steadily diminishing. In 1900 there were 13,116 deaths from this group of causes; in 1915 there were 1,090, a decrease of 12,026, or 91.7 per cent. But these deaths are distributed to the several ages of life in somewhat the same proportion as other causes of death, while cancer is characteristically a disease of adults and aged persons. Hence it is fairer to exclude all deaths ascribed to ill-

* In general terms this group includes every death which was said to be due to ill-defined organic disease, sudden death, or a cause ill-defined or not specified.

defined or unknown causes in which the decedents were less than 30 years of age. In 1900 there were in these registration states 6,362 deaths of persons over 30 years of age which were ascribed to ill-defined or unknown causes; in 1915 there were only 520, or about one twelfth as many. As the population increased, while the deaths decreased, the death rate from such causes fell still faster, from 74.9 per 100,000 population over 30 years of age in 1900 to 4.5 per 100,000 in 1915, or one sixteenth of the earlier rate.

An estimate of the number transferred from ill-defined causes to all other causes may be reached in the following way. If the rate in 1915 had been the same as in 1900, the deaths above 30 years of age from unknown causes would have been 8,696. The difference between that number and 520, or 8,176, represents the number probably transferred from ill-defined and unknown causes to some specific cause. If we assume that these were transferred in a random way, or in the proportions which each of those causes bore to all causes except the ill-defined group, then 9.6 per cent. of the 8,176 transfers, or 784, went to cancer. The actual increase in the cancer death rate between 1900 and 1915 was from 144.3 to 202.3 per 100,000 population over 30 years of age, or 40.2 per cent. If these 784 estimated transfers were excluded, the increase would be only from 144.3 to 195.5, or 35.5 per cent. On these assumptions between one ninth and one eighth, 11.7 per cent., of the apparent increase was due to transfers from ill-defined causes to cancer. But in assigning causes of death the modern tendency is away from vague, indefinite causes to specific, definite causes. Hence, the gain by transfers to cancer has probably been greater than a mere chance distribution of the transferred cases would indicate. If so, more than one ninth of the increase in the cancer death rate of the registration states of 1900 between 1900 and 1915 was due to a certification of deaths in 1915 as due to cancer which, under conditions existing in 1900, would have been returned as due to ill-defined or unknown causes.

In dealing with this aspect of the question, if errors are to be avoided, the specific conditions surrounding certification and registration in each country must be known, and espe-

cially whether the residual class of ill-defined and unknown has retained the same meaning throughout. This knowledge I have found it difficult to acquire and for that reason I have made no study of such transfers in other countries.

But after this warning it may be pointed out that in England and Wales, according to *March*, the deaths ascribed to unknown causes fell from 45,273 in 1858 to 3,318 in 1910, a decrease of 93 per cent. However, in this case there is reason to suppose that the meaning of the term *unknown* has changed.* In Scotland between 1855 and 1910 the deaths from unknown causes fell off by three fifths and, as the population increased, the death rate fell off by three fourths; in Ireland the death rate from unknown causes fell by one third between 1881 and 1910. In Prussia between 1875 and 1910 the deaths from unknown causes decreased from 101,633 to 18,434, or nearly five sixths and the rate about eight ninths; in Baden the decrease in deaths from unknown causes was from 1,381 in 1881 to 17 in 1910; in Italy from 22,977 in 1890 to 3,455 in 1910 and in the more populous divisions of Australia since 1891 similar changes have been in progress with great rapidity. All this evidence seems to warrant us in concluding that in many countries the assignment of deaths to cancer, which under earlier conditions would have been assigned to unknown or ill-defined causes, has played an important part in exaggerating the increase in reported cancer mortality.

2. Is the proportion of deaths reported as due to tumor decreasing? The reported death rate from tumor, or, more exactly, benign tumor, has been decreasing, while the death rate from cancer, sometimes called malignant tumor, has been increasing. These changes in opposite directions are probably to be ascribed in large part, if not entirely, to a more accurate discrimination between cancer and tumor, or a greater willingness among friends of the decedent to have the word *cancer* appear on the death certificate. As a result many deaths in recent years have appeared in the cancer column which under earlier conditions would have appeared as tumor. American evidence regarding this change goes back to a period

* *March*, I, p. 829 and II, p. 235. But see the divergent figures for 1901 under this head in the two volumes.

long before 1900. In the census of 1880, this statement appears: "The reported number of deaths from cancer . . . is undoubtedly too small, if we use the term 'cancer' in the ordinary sense, for there is very little doubt that most of the deaths reported as due to tumor . . . might properly have been classed with cancer."* Ten years later the same authority said: "As it is impossible from the census data to distinguish the cases of tumor from those of cancer, they will be considered together."† The same treatment was accorded to them in 1900.‡ The diminishing proportion that deaths ascribed to tumor made of all ascribed to cancer and tumor combined is shown below.§

PER CENT. THAT DEATHS FROM TUMOR MAKE OF TOTAL FROM CANCER AND TUMOR.

Date.	Census Returns for all United States.
1880	12.0
1890	11.7
1900	10.4
	Returns for Expanding Registration Area of United States.
1900–1904	2.3
1905–1909	1.5
1910–1914	0.9

The first three lines refer to deaths from any part of the United States as returned by the enumerators outside, and by medical certification inside, of the registration area. The other three refer to the registration area alone, which embraced in 1900 two fifths and in 1914 two thirds of the population of the country.‖ This expansion has carried registration into districts where the diagnosis of cancer is less trustworthy, probably, and hence the preceding figures obscure the results of improved diagnosis in an unchanging area. An idea of the exaggerated emphasis upon tumor as a cause of

* U. S. Census Office, *Tenth Census*, XII, p. cxiv.
† U. S. Census Office, *Eleventh Census, Vital Statistics*, pt. I, p. 336.
‡ U. S. Census Office, *Twelfth Census*, III, p. clxxxi.
§ See Appendix Table XXIV, for fuller data.
‖ U. S. Bureau of the Census, *Mortality Statistics, 1914*, p. 9.

death in the enumerators' returns alone may be derived from the complete data,* by subtraction. It appears that outside of the registration area of 1900, and thus in districts where the only source of information was enumerators' returns, 22 per cent. of the deaths from cancer and tumor were ascribed to tumor, but within the registration area at the same date only 2.9 per cent. of the deaths in that group were ascribed to tumor.

The evidence derived from the registration states of 1900 for the period 1900 to 1915 points to the same conclusion and is more weighty because the area covered by the figures did not change. In this case it is safe to speak of rates rather than of proportions. The results are as follows:

DEATH RATE PER 100,000 POPULATION IN REGISTRATION STATES OF 1900. (a)

Year.	Cancer.	Tumor.	Both.	Per Cent. of Deaths from Cancer.
1900	63.9	2.0	65.9	97.0
1901	65.8	1.6	67.4	97.6
1902	65.6	1.4	67.0	97.9
1903	69.0	1.7	70.7	97.6
1904	70.4	1.4	71.8	98.1
1905	72.4	1.4	73.8	98.1
1906	73.1	1.3	74.4	98.3
1907	75.7	1.2	76.9	98.5
1908	76.8	1.0	77.8	98.7
1909	79.4	1.0	80.4	98.8
1910	83.0	1.2	84.2	98.6
1911	83.9	0.8	84.7	99.1
1912	85.9	0.7	86.6	99.2
1913	88.7	0.5	89.2	99.4
1914	89.1	0.6	89.7	99.3
1915	91.8	0.5	92.3	99.4

(a) For the full table see Appendix, Table XXV.

In these 15 years the death rate from cancer has increased 27.9 per 100,000 population, but the death rate from tumor has fallen 1.5 per 100,000, so that the death rate from both combined has increased only 26.4 per 100,000. Thus the transfer from tumor to cancer seems to account for more than one twentieth of the total increase.

The influence of this progressive transfer of cases from tumor to cancer through a longer period is clearly revealed in the Massachusetts figures.† As the state classification differs

*Appendix, Table XXIV.

†For the full table see Appendix, Table XXVI.

from the federal and the latter is available only since 1900, I have relied throughout upon the former.

DEATH RATE PER 100,000 POPULATION IN MASSACHUSETTS.

Period.	Cancer.	Tumor.	Cancer and Tumor.	Per Cent. of Deaths from Cancer.
1853–1857	19.3	5.3	24.6	78.5
1858–1862	25.8	4.9	30.7	83.9
1863–1867	29.7	5.3	35.0	84.9
1868–1872	34.9	5.8	40.7	85.8
1873–1877	37.4	5.4	42.8	87.3
1878–1882	50.8	3.8	54.6	93.0
1883–1887	56.1	3.3	59.4	94.5
1888–1892	60.6	3.1	63.7	95.1
1893–1897	67.1	3.8	70.9	94.6
1898–1902	71.0	3.0	74.0	96.0
1903–1907	83.3	2.5	85.8	97.1
1908–1912	90.2	1.2	91.4	98.6
Increase or decrease (—) per 100,000	70.9	—4.1	66.8	

These figures indicate that about one seventeenth of the increase in the cancer death rate of Massachusetts was due to the certification of deaths at the close of the period as caused by cancer which under earlier conditions would have been ascribed to tumor.

The only article I have met with in which deaths from cancer and tumor are separately tabulated is one dealing with the statistics of Breslau for the period 1876–1899.* From its figures I have compiled the following:

Period.	Deaths from		Per Cent. from Tumor.
	Cancer and Tumor.	Tumor.	
1876–1879	666	94	14.1
1880–1884	969	67	6.9
1885–1889	1,291	69	5.4
1890–1894	2,024	204	10.1
1895–1899	2,729	307	11.3

A comparison of these figures with the others suggests that many of the deaths in Breslau ascribed to tumor are probably due to cancer and that there has been no steady improvement

* F. Frief, "Die in den Jahren 1876–1900 in Breslau vorgekommenen Todesfälle an Krebs," in *Klinisches Jahrbuch*, XII (1904), pp. 133–200.

in discriminating between the two causes of death such as is indicated by the American figures.

In England and Wales the Registrar-General in 1884 began the practice of sending an inquiry to every physician who reported a death without a satisfactory statement of its cause, and in 1887 extended this procedure to include every case of a death certified as due to tumor. In 1886 the deaths reported as due to cancer were 16,243, in 1911 they were 35,902, an increase of 18,659 in 25 years. But in 1911 there were 656 deaths which had been at first reported as due to tumor and which, after correspondence, were transferred to cancer. This number equals 3.5 per cent. of the increase. Probably a large, perhaps an equally large, number of cases in 1911 were returned in the first instance as cancer, although under the conditions of greater carelessness or ignorance prevalent before 1887 they would have been reported as tumor. This English evidence seems to corroborate the American by indicating that a significant part of the increase in the cancer death rate of recent years, a part which may be conservatively estimated as one twentieth, has been due to a transfer of cases from tumor to cancer.

3. Is the proportion of deaths reported as due to old age decreasing?

In the American registration states of 1900 the number of persons reported as dying of old age is steadily and rapidly decreasing. In 1900 it was 10,015 and in the same states in 1915 it was 4,380.* This change is not due to a decrease either in the total population or in those at high ages; for both the population and the proportion who die late in life to all deaths are growing. It is due rather to the unwillingness of many recording officials to receive vague statements of the cause of death and their efforts to secure on the death certificate a statement more specific and exact than "old age." Thus, in the *Manual of the International Classification of Causes of Death*, the *vade mecum* of American registration officers, the instruction under "old age" reads: "A very indefinite and unsatisfactory return as a cause of death. It is usually due to carelessness on the part of the physician and a more specific

* Appendix, Table XXVII.

statement should be required." The decrease in the deaths ascribed to "old age" is due, then, to the increasing care with which returns are made and the closer supervision of them by the registration officials, and the change is a rough index of the improvement of registration. Doubtless many of the deaths which would formerly have been ascribed to "old age" now appear under cancer, contributing to swell the increase in the recorded, as distinguished from the actual, cancer death rate.

To estimate the proportion of the increase in cancer mortality which can be thus explained, it is necessary to estimate first the number of deaths transferred from old age to all other causes and then the proportion and number which have gone to cancer. For this it is probably best to assume a constant ratio between the number of deaths ascribed to old age and the number of deaths of all persons above 60 years of age. In the registration states of 1900 this proportion in 1900 was 9.9 per cent. and in 1915 it was 3.2 per cent. If the per cent. had remained unchanged, 13,697 deaths would have been ascribed to old age in 1915; the number actually ascribed to it was 4,380. Hence it is probable that there were not far from 9,317 deaths in 1915 which under earlier conditions would have been ascribed to old age but which were ascribed to some other cause as a result of improvements in reporting causes of death. Of these 9,317 deaths, the number transferred to cancer may be estimated by assuming that the proportion was equal to that which the deaths above 60 years of age from cancer make of the deaths at that time of life from all causes except old age. This would indicate that 9.3 per cent. of the 9,317 deaths, or 866, were transferred from old age to cancer. If these 866 deaths be subtracted from the total ascribed to cancer in 1915, the increase in the cancer death rate during the 15 years 1900–1915 is reduced from 27.9 to 24.6 per 100,000. In other words, the transfer from old age to cancer serves to account for about 12 per cent. of the entire increase. But the tendency to change from old age to cancer must have been much greater than the tendency to change from old age to heart failure or general debility or some other meaningless term. If so, the transfers from old age to cancer in this

instance must account for more than 12 per cent. of the increase in cancer mortality.

The difficulties which prevented an international study of the transfers from ill-defined and unknown causes to cancer do not equally hamper a study of the transfers from old age. I have found no reason to suppose that the heading *old age* or its counterpart in the international classification, *senile debility* or *senility*, has materially changed its meaning. The decreasing death rate from this cause is shown in the following table, giving the death rate from old age for every fifth year since the record began. The data are taken from *March*.

DEATH RATE PER 100,000 POPULATION FROM OLD AGE, OR SENILITY, VARIOUS EUROPEAN STATES.

Year	England and Wales.	Scotland.	Ireland.	Norway.	Switzerland.	Prussia.	Bavaria.	Baden.	Italy.
1855		191							
1860	143	215							
1865	136	183	173						
1870	128	192	295	38					
1875	119	169	405	49		264			
1880	100	129	432	48	112	251			
1885	103	123	381	45	125	247		197	
1890	98	116	401	44	130	248	245	215	101
1895	98	110	388	107	128	221	213	182	125
1900	99	103	364	175	170	236	209	173	148
1905	92	84	197	194	73	201	191	154	143
1910	88	74	208	187	55	167	161	146	140

The preceding figures show that in most of the countries the death rate from old age is now falling and that in several it has fallen without interruption from the first. Probably in all these countries the proportion of deaths at ages above 60, 70, or 80 to all deaths or to all persons living is increasing. Hence many deaths must be now ascribed to other causes which, under earlier conditions, would have been ascribed to old age, and no small proportion of these must have gone to cancer.

The preceding estimates explain away not less than three tenths of the increase in the reported mortality from cancer, namely, transfers from ill-defined or unknown causes to cancer perhaps 12 per cent., transfers from old age to cancer perhaps 12 per cent. and transfers from tumor to cancer perhaps

6 per cent. But the two larger figures have been reached by assuming that the transfers from indefinite to definite causes had a random distribution among the groups to which they went, while in fact the distribution tends to center on specific and precise causes. For this reason the results may fairly be deemed minimum figures and not a little below the truth. Accordingly, I conclude that from three tenths to one half of the increase in the death rate from cancer in the registration states of 1900 is due to the causes mentioned and is apparent rather than real.

If to these results we add the earlier conclusion that, on the average, not less than one tenth of the increase in cancer mortality is due to the increasing proportion of adult and elderly persons in the population, I conclude that not less than four tenths and perhaps as much as six tenths of the increase in cancer mortality has been explained as only apparent.

These are all the results of improved diagnosis and certification upon the recorded cancer mortality which I have found any means of measuring even roughly. There are other changes, however, which have already been mentioned and need examination, although their influence cannot be measured.

4. Is the mortality from cancer low where there are few physicians or where a small proportion of the death certificates are prepared by physicians and vice versa?

We have already (p. 725) touched upon the relation between the reported death rate from cancer and the proportion of deaths certified by laymen. But additional evidence on this point may now be presented. In Saxony, of all deaths certified as due to cancer the per cent. certified by laymen was 18 in 1876 and steadily decreased to 4 in 1903.* Hence, where certificates from doctors are few, the cancer mortality is likely to be low. In this respect no country, perhaps, includes greater extremes than Austria; Vienna is one of the medical centers of the world; Bukowina and Galicia are most meagerly furnished with physicians. *Prinzing* gives for each of the 17 provinces of Austria in the five year period 1896–

* Georg Radestock, "Die Krebsterblichkeit im Königreich Sachsen in den Jahren 1873–bis 1903," in *Zeitschrift des k. Sächsischen Statistischen Landesamtes*, LI, Pt. II, p. 263.

1900 the per cent. of deaths the causes of which were certified by physicians,* and *Hoffman* gives the death rates from cancer, 1907–1911, in the same provinces.† As the two returns do not speak for the same period, I have sought for the per cent. of medically certified deaths in the later years. The source‡ gives the information only for 1907 and 1910. From this material I have computed the per cents. in the third column of the following table:

Province.	Death Rate from Cancer per 100,000 Population 1907–1911.	Per Cent. of Deaths which were Medically Certified	
		1896–1900.	1907 and 1910.
Salzburg	140	99.0	99.9
Upper Austria	136	98.2	99.3
Vorarlberg	125	96.3	98.4
Lower Austria	120	99.7	99.9
Tyrol	110	93.0	94.2
Bohemia	104	99.1	99.7
Trieste	99	98.8	99.9
Moravia	97	94.4	95.8
Styria	96	79.9	83.7
Corinthia	83	72.4	77.5
Silesia	67	70.1	74.7
Carniola	49	35.0	35.9
Görz and Gradiska	46	43.1	47.1
Bukowina	46	32.8	33.7
Istria	43	44.7	51.0
Galicia	33	26.5	27.6
Dalmatia	24	29.1	30.5
All Austria	79	68.0	68.5

Among the many factors which influence the reported death rate from cancer in Austria, there is one, the proportion of deaths certified by physicians, so potent as largely and, where the differences are great, almost exclusively to determine the rate. Evidently the very low reported death rate from cancer in Dalmatia and Galicia is due to the few reports from physicians and not to the infrequent occurrence of cancer in those provinces. A comparison of the second and third columns in the table shows that the proportion of medically certified deaths in every province increased between the earlier and later dates. The increase in the Austrian death rate from

* P. 326.

† P. 680.

‡ *Oesterreichische Statistik.* The figures were kindly furnished by the New York Public Library.

cancer during the same period from 69 to 78 per 100,000 was doubtless connected with this spread of medical certification.

The following table has been compiled from one in *Hoffman** by arranging the countries of Europe in the order of the cancer death rate.

Country.	Period.	Death Rate from Cancer per 100,000 Population.
Denmark (cities)	1908–1912	142
Switzerland	1908–1912	124
Holland	1908–1912	106
Sweden (cities)	1907–1911	105
Scotland	1908–1912	103
England and Wales	1908–1912	98
Norway	1908–1912	97
German Empire	1908–1912	87
Ireland	1908–1912	81
Austria	1908–1912	80
France	1906–1910	76
Belgium	1908–1912	67
Italy	1908–1912	65
Rumania (cities)	1907–1911	62
Spain	1908–1912	52
Greece (cities)	1904–1908	52
Hungary	1908–1912	46
Portugal	1906–1910	22
Serbia	1905–1909	12

This suggests that in the countries of Europe the cancer death rates vary, as in the provinces of Austria they have been shown to do, in general agreement with the number and quality of the physicians, or the proportion of deaths which are medically certified. But I have found no figures showing the proportion of physicians to population or the proportion of medically certified deaths in these countries and therefore must content myself with raising the question without answering it.

5. Can any differences be traced between the amount or the increase of cancer mortality in city and country?

The cities of the United States having at least 25,000 inhabitants in 1900 had 232 physicians to every 100,000 people and the rest of the country had 153, or only two thirds as many. Probably the number of visits made by a physician annually is greater in cities than in the country and the quality of his training is better. The proportion of young adults with lives

* P. 594.

economically of high value is also greater in cities, and not a few invalids migrate to cities to avail themselves of medical and hospital advantages. All these circumstances would lead one to look for a higher cancer death rate in cities, if the assumption were correct that a direct and important connection exists between the number and quality of the physicians in a community, and its reported death rate from cancer. On the other hand, in country districts the proportion of aged persons peculiarly liable to cancer is larger. If, notwithstanding this physical basis for a higher cancer death rate in the country, the cities actually have the higher reported rate, then the difference is doubtless due in considerable measure to the larger number and greater ability of city physicians, if we assume that there is no actual difference in the liability of the two populations at the same ages to die of the disease. Now, in the cities of the registration states of 1900 the death rate from cancer in 12 of the 16 years during the period 1900–1915 was greater than in the country districts, indicating that in the United States there may be a connection between the proportion of physicians to population and the reported death rate from cancer.*

Between 1900 and 1915 the death rate from cancer in the cities of the registration states increased from 66.0 to 91.3 per 100,000, or 38.0 per cent. Meanwhile the country rate increased from 61.4 to 92.8, or 51.0 per cent., a more rapid increase in the country rate. During the same period we may be sure from evidence already given that hospital facilities and their use increased quite out of proportion to population. Hence there can be little doubt that deaths from cancer occurring in a hospital are now a larger proportion of all such deaths than formerly they were. And it is almost as certain that the current of cancer patients from country districts to city hospitals is increasing. If so, and if there are no other real differences between the cancer mortality of city and country districts than those due to differences in the proportion of elderly persons, the more rapid increase of the reported death rate from cancer in the country shows that some change, perhaps improved diagnosis and certification, has progressed so

* Appendix, Table XXVIII.

much more rapidly in the country as to overbalance the growing drift of cancer patients from country to city.

The tables in the international publications already mentioned facilitate a comparison between cities and country districts in certain European countries. Thus for England the population and deaths from cancer since 1880 are given for Birmingham, Bradford, Derby, London, and Liverpool by *Falkenburg*, and for the whole country by *Hoffman*. By subtracting the urban totals from those for all England a rough division between city and country is reached. In the same way the rates for Edinburgh and Glasgow combined may be compared with those for the rest of Scotland, those for Christiania with those for the rest of Norway, those for Amsterdam, the Hague, Rotterdam, and Utrecht with those for the rest of the Netherlands, and those for Vienna and Prague with those for the rest of Austria.* The computation shows that in sixteen out of twenty cases the crude urban rate was higher than that in the rest of the country and that in every country but England the increase in rate between 1881 and 1909, or in the case of Austria 1881 and 1908, was more rapid in the country districts, thus indicating that in Europe the difference between city and country has been decreasing. The figures for Austria are especially noteworthy. In 1881 the death rate from cancer in Vienna and Prague was 119.0, in 1908 it was 133.0. In the rest of Austria the rate in 1881 was 38.6, in 1908 it was 75.0. While the urban rate was increasing 12 per cent., the rural rate increased 94 per cent. In view of the other evidence which has been presented regarding conditions in the various provinces of Austria, it seems probable that nearly all of this increase in cancer mortality outside of the two capitals is due to improved diagnosis and certification.

Apparently, then, cancer mortality in cities, or at least in great cities, is usually higher but increasing more slowly than it is in country districts, so that in this regard the difference between city and country is decreasing. This is especially true wherever the initial differences between city and country are very wide.

6. Is the death rate from cancer among Negroes less than it is among whites?

* For detailed figures, see Appendix, Table XXIX.

The greater longevity of the whites would result in a higher cancer death rate among all whites, even if there were no difference in the death rates of persons of the same age belonging to the two races. If the true cancer death rates of the two races at the same age periods are the same but medical attendance and certification are poorer among Negroes, then the reported Negro death rate from cancer would be the lower. Unfortunately the death rates by race are available for only 6 years, 1910–1915. They speak for the registration states of 1910 and embrace an annual average of over 39,000 deaths from cancer of whites and 900 deaths of colored, nearly all of them Negroes. The results are as follows:*

Date.	Death Rates from Cancer per 100,000 Population Classified by Race in Registration States of 1910.		Per Cent. that Death Rate among Colored is of that Among White=100.
	White.	Colored.	
1910	76.8	52.6	68.4
1911	77.0	59.3	77.0
1912	79.8	59.3	74.3
1913	82.6	64.0	77.5
1914	83.5	65.4	78.3
1915	85.4	68.8	80.6
Per Cent. increase.	11.2	30.8	

The reported death rate of colored from cancer is from two thirds to four fifths that of the white, but is increasing faster, so that the difference between the races is diminishing. In view of the short period, the small number of Negro deaths involved and the erratic figures, no great weight can be given to the results.

I have obtained similar figures for the registration states of 1900, a much smaller area, in the same years. They have one advantage—they can be safely compared with figures for 1900.†

* For figures in full see Appendix, Table XXX.

† The figures for 1900 refer to the census year rather than to the calendar year and the area embraced differs from that of the registration states of 1900 by excluding Indiana. But these differences do not materially affect the significance of the comparison here made.

Date.	Death Rates from Cancer per 100,000 Population Classified by Race in Registration States of 1900.		Per Cent. that Death Rate among Colored is of that Among White=100.
	White.	Colored.	
1900	62.5	41.3	66.1
1910	83.4	60.5	72.5
1911	84.1	74.2	88.5
1912	86.2	71.5	83.0
1913	89.0	70.8	79.6
1914	89.4	72.1	80.6
1915	92.1	79.4	86.2
Per Cent. increase.	47.4	92.2	

Here again it appears that the death rate from cancer among the colored is lower but increasing faster than that among the white. The changes from year to year are irregular. A comparison of the two tables shows that the death rate from cancer is uniformly greater for each race in the smaller region from which the states recently added to the registration area are excluded, as in the second table, a fact agreeing well with the theory that differences in the cancer death rates are due largely to the efficiency of the registration system, which even under the best of fostering care must be a plant of slow growth.

Mr. Hoffman's tables* show that in 8 large Southern cities between 1891 and 1914, the first and last years covered, cancer mortality among whites increased by 73 per cent. and that among Negroes by 92 per cent. He has long given special attention to the statistics of Negroes in the United States and notes that prior to the Civil War cancer among them was rare, that the present difference between the two races is less pronounced, but that the cancer mortality of Negroes is still materially below that of whites.† These conclusions by one who accepts the opinion of qualified medical observers that "cancer is exceptionally rare among primitive peoples,"‡ are equally consistent with my own belief that much, if not all, of the difference is due to differences in the accuracy of diagnosis.

* *Op. cit.*, p. 474.
† *Ibid.*, p. 15.
‡ *Ibid.*, p. 147.

7. Has the death rate from cancer increased more rapidly at the higher age periods than earlier in life?

The Census Bureau has kindly furnished me with a table showing the cancer mortality in the registration states of 1900 classified by age and sex for the two years 1900 and 1910.* From these figures the following percentages of increase have been computed.

PER CENT. INCREASE IN THE DEATH RATE FROM CANCER BY SEX AND AGE IN THE REGISTRATION STATES OF 1900 FOR THE PERIOD 1900-1910.

Age.	Per Cent. Increase.	
	Males.	Females.
25–34	4	16
35–44	17	13
45–54	28	17
55–64	44	24
65–74	31	33
75+	34	42

The figures are not perfectly regular and yet they do show clearly that in each sex the increase at the higher ages is more rapid than that at the lower ages.

Similar evidence extending over a longer period of time is furnished by the Massachusetts records. The rates for a single year, when classified by sex and age, are often based on too few cases to be entirely trustworthy. The records cover the 6 census years 1860–1910, which, with due consideration of the sex differences, gives 10 cases.† In one of the 10 the most rapid increase was at ages over 80; in 3 it was at 70–79, in 3 it was at 60–69, and in only 3 was it at any period below 60, all 3 being at 30–39. This supports the previous conclusion that the increase of cancer mortality is greatest toward the end of a normal lifetime.

Similar rates for a series of decades are to be found in the successive decennial supplements to the *Reports of the Registrar General* and for 1901–1910 in his *Seventy-third Annual Report* for 1910. From them the following percentages of increase have been derived. As each rate speaks for a 10

* Appendix, Table XXXI.
† Appendix, Table XXXII.

year period and for a large population, the results are more regular and more significant than those previously reached.

PER CENT. OF DECENNIAL INCREASE IN THE DEATH RATE FROM CANCER BY SEX AND AGE IN ENGLAND AND WALES.

Age.	Per Cent. of Decennial Increase.			
	1861–1870. to 1871–1880.	1871–1880 to 1881–1890.	1881–1890 to 1891–1900.	1891–1900 to 1901–1910.
	Males.			
25–34	18	14	26	?
35–44	17	25	29	13
45–54	32	42	30	25
55–64	33	45	38	28
65–74	74	44	42	34
75+	32	31	49	?
	Females.			
25–34	9	0	2	?
35–44	18	8	5	−1
45–54	16	16	14	5
55–64	20	22	22	11
65–74	26	28	29	22
75+	26	31	39	?

The preceding figures all show that the increase in cancer mortality is greater at the higher ages. Incidentally the last series shows also that the increase of cancer among men is more rapid than that among women and that during the last decades observed there was a slight fall in the cancer mortality of English women between 35 and 45 years of age.

This more rapid increase at the higher ages is quite probably connected with improved diagnosis and certification. Ignorant or careless certification is likely to affect more seriously deaths not only of the weaker economic classes, like the Negroes, but also of the less economically valuable age periods, like those near the end of a normal lifetime. Hence an improvement in cancer diagnosis and certification would affect especially the increase in the reported death rate at later ages.

8. Is the increase in mortality from such forms of cancer as are difficult to diagnose more rapid than the increase in the forms easy to diagnose?

The classification of deaths from cancer made by Messrs. King and Newsholme into accessible and inaccessible cases suffers from one questionable assumption. It tacitly assumes that such a dual classification is possible. In fact cases of cancer fall into a series with those easy of diagnosis at one end and those very difficult of diagnosis at the other. One important element, perhaps the most important element, in determining the position of any specific case on that scale is the part of the body involved. A recent bulletin of the federal Census Bureau* affords an objective test of this element by indicating what proportion of cases of each location were diagnosed by the reporting physician with reasonable certainty. It furnishes what students of the statistics of cancer have lacked hitherto, an objective basis for classifying deaths from this cause according to the certainty of the diagnosis and the part of the body first attacked. This classification has been derived from the physicians who reported 52,420 deaths from this disease in 1914. Their statements showing whether the diagnosis in each case rested on clinical evidence alone or had been confirmed by operation or autopsy enabled the Washington office to divide these 52,420 deaths into those in which the diagnosis was reasonably certain and those in which it was uncertain. From these figures the following results have been derived:

* *Mortality from Cancer and other Malignant Tumors in the Registration Area of the United States, 1914.*

DEATHS FROM CANCER CLASSIFIED ACCORDING TO PART OF BODY AFFECTED, SHOWING PER CENT. WITH DIAGNOSIS UNCERTAIN, REGISTRATION AREA OF UNITED STATES, 1914.

Part of Body Affected.	Number of Deaths Excluding Those with Diagnosis Unknown.	Cases where Diagnosis was Uncertain.	
		Number.	Per Cent.
Breast	5,421	1	0
Skin	1,957	0	0
Jaw	851	1	0
Tongue	614	0	0
Lip	376	0	0
Mouth	230	0	0
Vagina and vulva	184	0	0
Testes	121	0	0
Uterus	7,468	8	0.1
Larynx	341	1	0.3
Rectum	2,164	14	0.6
Ovary and fallopian tube	366	56	15.3
Pancreas	567	219	38.6
Kidneys and suprarenals	434	171	39.4
Brain	98	39	39.8
Bladder	764	305	39.9
Peritoneum and mesentery	387	159	41.1
Bones (except jaw)	359	156	43.5
Prostate	625	314	50.2
Intestines	3,121	1,632	52.3
Lung and pleura	278	157	56.5
Pharynx	42	24	57.1
Esophagus	484	285	58.9
Liver and gall bladder	4,777	3,421	71.6
Stomach	9,681	6,973	72.0

These results furnish a test of the agreement between the classification by the American Census Bureau into cases of certain and uncertain diagnosis and the classification by Messrs. King and Newsholme into accessible and inaccessible cases. The English authorities included under accessible only cancers of the tongue, mamma, uterus, and vagina. The foregoing figures confirm this classification in every respect, but suggest that to these might well have been added cancers of other parts of the mouth than the tongue, of the skin, of the larynx, of the testes, and of the rectum. But cancers of the skin, the mouth, and the testes were not given separately in the Frankfort printed sources which they used, and they point out that, in their figures, cancers of the larynx and the rectum were so few or increased so little that a change in the classification of these would not affect the argument.

We may conclude that the dual classification of Messrs. King and Newsholme is justified by these results. A sharp line separates the accessible cases from the inaccessible and to

the former class, in addition to those placed there by Messrs. King and Newsholme, belong cancers of the mouth, larynx, skin, rectum, and testes. But the cases of inaccessible cancer may be ranged roughly in a series according to the reported uncertainty of the diagnosis from cancer of the ovary and fallopian tube at one extreme to cancer of the stomach, liver, and gall bladder at the other. If the increase of cancer is largely due to improved diagnosis and the classification of cases according to the part of the body affected is correct and complete, then the rapidity of increase in the reported rate for inaccessible cancer of any particular internal organ and the period through which it persisted would probably vary with the difficulty of diagnosis. It may be wise in future to attempt an improvement of the method introduced by Messrs. King and Newsholme in conformity with this suggestion, but for the present the American material is entirely inadequate for such a study and that from other countries cannot be easily found or interpreted with confidence.

9. Is the rate of cancer mortality lower and its increase faster among men than among women?

The evidence upon which an affirmative answer to both branches of this question is based has already been reviewed in the examination of that part of Messrs. King and Newsholme's argument (pp. 705, ff.).

10. Does the increase of cancer mortality depend upon the initial rate, being high when that rate is small and diminishing or even disappearing when it approaches or reaches a certain high rate?

If the assumption which we are trying to test is correct, if the true death rate from cancer varies only with age and all other variations in the reported rates depend upon the accuracy of those rates and so upon the accuracy of diagnosis, then the increase would be likely to depend upon and vary with the initial rate. So long as the reported rate remained far below the true rate, the increase might be constant or might vary irregularly; but when the reported rate drew near the true rate and the opportunities for further improvements of diagnosis began to disappear, the increase would inevitably slacken. On the other hand, if the spread of the disease were actual, there would be no apparent reason why the disease should

grow only towards or to some fixed limit. With the large amount of material recently brought together by the various international compilations, it has become possible to test this inference from our assumption on a scale hitherto quite out of the question.

We may test the theory first in its application to the 22 countries for which the cancer death rates have been computed from data found in *March*.* From these rates quinquennial averages have been computed and the average increase in these per cents. has been determined, the results being given in the following table:

Range of Quinquennial Rates.	Number of Rates Involved.	Average Rate of Increase in Next Five Years.	
		Amount.	Per Cent.
0–29	10	4.7	21.7
30–39	19	6.5	18.9
40–49	20	6.7	15.1
50–59	17	8.6	15.9
60–69	15	8.3	12.8
70–79	6	7.5	9.8
80–89	5	10.7	12.7
90–99	8	5.3	5.5
100+	5	4.0	3.5

* The data speak for the following countries and dates, a total of 694 years.

Country.	Period.	Number of Years.
England and Wales	1858–1910	53
Scotland	1855–1910	56
Ireland	1864–1910	47
Norway	1870–1910	41
Austria	1873–1910	38
Switzerland	1877–1910	34
German Empire	1892–1910	19
Prussia	1875–1910	36
Bavaria	1888–1910	23
Saxony	1892–1910	19
Würtemberg	1892–1910	19
Holland	1875–1910	36
Spain	1900–1910	11
Italy	1887–1910	24
Serbia	1892–1910	19
New South Wales	1875–1910	36
Victoria	1864–1910	47
Queensland	1879–1910	32
South Australia	1879–1910	32
West Australia	1891–1910	20
Tasmania	1891–1910	20
New Zealand	1879–1910	32

The cancer death rates for each country in each year will be found in Appendix, Table XX. In some instances they will be seen to differ slightly from the rates given in *Hoffman*. As the *March* volumes received the coöperation and aid of the statistical offices of the various countries and I have found no reason to question their accuracy, I must ascribe these differences to differences in classification. I believe the early and later figures for each country in *March* are comparable and that is the important matter.

With two exceptions the per cent. of increase in the cancer mortality fell as the initial rate rose and after the initial rate reached 80 the average amount of increase also fell rapidly as the initial rate rose.

A similar line of argument has been applied to the larger and more trustworthy body of material in *Falkenburg* and *Hoffman* for cities of at least 100,000 population. Each 5 year rate for each city has been obtained, these rates have been arranged in order of size, the increase (or decrease) between each 5 year rate and that for the following 5 years obtained and from these figures the average increase for each group within certain limits has been found. The results have been brought together in the following summary:

Range of Quinquennial Rates.	Number of Rates Involved.	Average Rate of Increase in Next Five Years.	
		Amount.	Per Cent.
0– 9	11	1.0	19.1
10–19	6	8.4	59.4
20–29	11	8.2	31.7
30–39	32	6.3	17.9
40–49	63	7.2	16.0
50–59	76	7.5	13.6
60–69	83	7.1	11.1
70–79	74	9.6	12.9
80–89	44	6.4	7.5
90–99	46	4.1	4.3
100+	85	4.9	4.2

Here, too, the average per cent. of increase falls almost from the start as the initial rate rises and the amount of increase also falls rapidly after a certain rate, in this instance 70 per 100,000, is reached.

To supplement this information for the leading countries and cities of the world, I have employed the returns of the annual volumes of American *Mortality Statistics* for the 15 year period, 1900–1914. They embrace 49 American cities, each having at least 100,000 inhabitants in 1910, while the preceding tabulation included less than half as many American cities. In this case, instead of computing quinquennial averages, the rate in 1900 has been compared with that in 1914.

Range of Initial Rates.	Number of Rates Involved.	Average Rate of Increase in Next Fourteen Years.	
		Amount.	Per Cent.
30–39	3	42.0	116.0
40–49	5	31.3	68.7
50–59	10	31.6	58.6
60–69	18	28.4	44.6
70–79	6	21.7	29.1
80+	7	17.7	20.4

Here, too, it appears that the average per cent. of increase slackens regularly and rapidly as the initial amount rises. The average amount of increase also falls regularly but the change does not appear until a certain rate, in this case 50 per 100,000, is reached.

One more effort to widen the inductive evidence has been made. In *Mortality Statistics, 1909*, the death rates from cancer in each year of the preceding decade is reported for 142 cities which in 1910 had between 20,000 and 100,000 inhabitants. These cities are so small that it is unsafe to take the death rate of a single year as a standard. To avoid the difficulty, I have compared their average cancer death rate 1900–1904 and 1905–1909 city by city. As a shorter period of time is used, the results are correspondingly less important.

Range of Quinquennial Rates.	Number of Rates Involved.	Average Rate of Increase in Next Five Years.	
		Amount.	Per Cent.
0–39	9	12	35
40–59	54	11	22
60–79	50	9	15
80+	29	10	12

The preceding table shows that these smaller cities in general conform to the rule already illustrated in the rates for the foreign countries and larger foreign and American cities. In the death rate of the cities with a low initial rate the absolute increase somewhat exceeds that in cities with a high initial rate and the percentage of increase, which in my judgment is

the fairer test, is much more rapid. The results from an extensive study of all these compilations of cancer statistics corroborate each other and constitute, I believe, strong evidence in support of the theory that the apparent increase in cancer mortality is not real.

Arguments from analogy are seldom of value in matters of this sort, but one analogy, that of appendicitis, seems to deserve mention. The opinions of physicians and surgeons regarding the actual increase of this disease diverge as widely as they do regarding the increase of cancer. Yet a confident belief in the increase of appendicitis is probably less general than the same belief regarding cancer, a larger proportion of medical men being ready to ascribe the increase of appendicitis to better diagnosis. Indeed many physicians are surprised to learn that in that part of the United States for which the facts are known the deaths reported from appendicitis are multiplying as fast as deaths from cancer. The following figures show the rates and the increase of each disease in the registration states of 1900 for each year between that date and the present.*

Year.	Death Rate per 100,000 Population.		Ratio of Rate to that of 1900=100.	
	Cancer.	Appendicitis.	Cancer.	Appendicitis.
1900	63.9	8.8	100	100
1901	65.8	8.8	103	100
1902	65.6	8.8	103	100
1903	69.0	9.6	108	109
1904	70.4	10.3	110	117
1905	72.4	10.2	113	116
1906	73.1	10.3	114	117
1907	75.7	10.2	118	116
1908	76.8	10.3	120	117
1909	79.4	10.8	124	123
1910	83.0	11.1	130	126
1911	83.9	11.3	131	128
1912	85.9	11.0	134	125
1913	88.7	11.6	139	132
1914	89.1	12.2	139	139
1915	91.8	12.3	144	140

A similar but more rapid spread of appendicitis in England is indicated by the reports. The mortality from it before 1901 is unknown. "The recorded death rate has increased

* For complete figures see Appendix, Table XXXIII.

from 38 per 1,000,000 in 1901 to 66 in 1910."* How much of this increase in either country is due to the better diagnosis of a disease which always attacks an inaccessible organ, I see no present means of determining.

SUMMARY OF RESULTS

The reported mortality from cancer is increasing in almost every part of the world, but the real mortality, if increasing at all, is certainly not increasing with equal rapidity.

To determine whether there is a real increase or to justify a denial of it, such parts of the reported increase as are not real must be measured and substracted from the total, in order to ascertain whether there is a residuum not thus to be explained away. For dealing with this problem, corrected, or standardized, death rates are likely to be misleading rather than helpful because the amount and rate of increase shown by them depend largely upon the standard used. This conclusion opens a way for using the data in the international compilations recently published, none of which are in the shape of corrected rates or can readily be converted into them.

A substitute for standardized rates as a way of measuring how much of the increase in the reported death rates from cancer is due to changes in the sex and age composition of a population during any period studied has been applied to 5 cases with the result that between one sixteenth and fourteen sixteenths and, on the average, one third, of the increase was found to be so accounted for. Evidently the part varies widely, but to assume that not less than one tenth of the reported increase of cancer mortality is due to changes in sex and age composition seems a conservative inference.

The remainder, perhaps nine tenths of the increase, must be explained by improved diagnosis, or accepted as actual.

Cancer mortality is lower but increasing faster among men than among women. Both differences may be due to the fact that among men the organs chiefly attacked by cancer are inaccessible while among women they are accessible. Hence the scope for improving the diagnosis of cancer among men was and is much wider.

* England and Wales, *73rd Annual Report of the Registrar General* (1910), p. lxxii.

The argument that the Frankfort corrected rates, 1860–1890, indicate that the increase was confined to inaccessible cancer and, therefore, was probably due entirely to improved diagnosis is strengthened by compiling the Frankfort data, 1890–1913, from official manuscript sources, nearly doubling the period observed and trebling the material.

When the death return comes from anyone but a physician, the cause of death is seldom reported as cancer. Hence there is a uniform and close connection between the proportion of deaths certified by physicians and the proportion ascribed to cancer.

The reported cancer mortality is low in those Austrian provinces where medical certificates are few and higher where they are many. A similar relation is suggested in Europe when the countries are arranged in order of cancer mortality, Switzerland having the highest rate and Serbia the lowest. This is of the first importance for the present problem, because in many countries the proportion of deaths certified by physicians is rapidly rising. Even when this is not the case, the proportion of ignorant and incompetent physicians is usually decreasing, a change which would tend to the same result.

At ages when the cancer mortality is highest the proportion of deaths certified by physicians to all deaths is much lower than in early middle life. Hence at those high ages there has been more room for a change from certification by a layman to certification by a physician and probably such changes have been made on a large scale.

The increase in cancer mortality is greatest at the upper ages, when the economic value of a life is least and diagnosis a few decades ago was probably most faulty.

The facilities for diagnosing cancer by microscopical examination of the diseased tissues, etc., are probably better in cities than in the country and better in hospitals than in general practice. Hence the disproportionate increase of urban population, the multiplication of hospital beds and, in many European countries, the increase of autopsies make for greater accuracy in the diagnosis of cancer.

The deaths ascribed to ill-defined or unknown causes in the American registration states of 1900 decreased between 1900

and 1915 to less than one tenth of the initial number and the death rate still faster. If these deaths no longer ascribed to ill-defined or unknown causes were distributed over the other causes in a random way, the transfer to cancer accounted for about one ninth of the increase in the reported mortality from that disease. This is probably an understatement of the proportion to be so explained. Similar changes have occurred in many other countries.

The deaths ascribed to tumor in the American registration states of 1900 decreased between 1900 and 1915 to a little over one fourth and the rate to one fourth of the initial figure. Where deaths were reported in 1900 only by enumerators, and so negligently, the proportion ascribed to tumor to all ascribed to tumor or cancer was 7 times as great as within the registration area in the same year. The change from tumor to cancer in the registration states between 1900 and 1914 and in Massachusetts between 1855 and 1912 seems to account for one twentieth of the increase in the cancer death rate. English evidence seems to corroborate the American.

The deaths ascribed to old age in the American registration states of 1900 decreased between 1900 and 1915 to a little more than two fifths, and the rate to less than one third, of the initial figure. The transfers from old age to cancer probably account for at least one eighth of the increase of cancer mortality in those states, 1900–1915.

The measurable influences swelling the increase in the reported mortality from cancer above the true mortality, namely, the increasing proportion of elderly persons in the population, the transfers from ill-defined and unknown causes, from tumor and from old age to cancer seem to account in the American registration states for fully one half of the reported increase, leaving another half to be otherwise explained or accepted as real.

Arguments contributing to explain away this remaining half either cannot yet be stated in the quantitative form, or, if so, cannot be combined with the preceding by any process of addition.

If it should prove to be a general rule, as it apparently is true in Frankfort, that the increase is confined to mortality

from inaccessible cancer, that would go far towards establishing the view that the whole increase was only apparent. But notwithstanding fragments of evidence from other districts, this form of argument is still restricted in the main to the Frankfort material.

In cities the cancer mortality is usually higher but increasing more slowly than in country districts and that notwithstanding the larger proportion of aged persons with high cancer mortality in the country. This may be connected with the larger proportion, greater accessibility and expertness of city physicians,—factors which have brought to the city records a large number of cancer deaths which would have been reported otherwise in the country. The difference between the two regions is decreasing and will perhaps continue to decrease, as the improvement in city records slackens as they approach perfection and the improvement in the country records accelerates for a time.

Cancer mortality among Negroes in the United States is lower but increasing faster than among whites. It seems likely that this is due to marked but diminishing differences in correctness of diagnosis.

The increase in cancer mortality varies roughly with the size of the initial rate, tending, after a certain moderately high rate is reached, to decrease as the initial rate rises.

In England and the United States the increase in cancer mortality is parallel with the increase in mortality from appendicitis and both may be due entirely, as they certainly are in large degree, to the improvement of diagnosis.

The cumulative evidence that improvements in diagnosis and changes in age composition explain away more than half and perhaps all of the apparent increase in cancer mortality rebuts the presumption raised by the figures and makes it probable, although far from certain, that cancer mortality is not increasing.

APPENDIX

TABLE I (a)

DEATH RATE FROM CANCER CLASSIFIED BY SEX FOR CONNECTICUT, MAINE, MASSACHUSETTS, NEW HAMPSHIRE AND RHODE ISLAND, BY FIVE YEAR PERIODS, 1896–1910.

Period.	Population.	Deaths from Cancer.	Death Rate per 100,000 Population.
	MALE.		
1896–1900	12,462,345	5,755	46.2
1901–1905	13,539,529	7,253	53.6
1906–1910	14,863,173	9,136	61.5
	FEMALE.		
1896–1900	12,839,093	11,592	90.3
1901–1905	13,891,724	14,016	100.9
1906–1910	15,102,303	16,741	110.9

(a) Data from *Hoffman*, pp. 456–469.

TABLE II (a)

DEATH RATE FROM CANCER CLASSIFIED BY SEX, REGISTRATION STATES AS CONSTITUTED IN 1900, (b) FOR YEARS 1900–1915.

Year.	Population.	Deaths from Cancer.	Death Rate per 100,000 Population.
	MALE.		
1900	10,004,754	4,703	47.0
1901	10,222,010	4,982	48.7
1902	10,439,266	4,950	47.4
1903	10,656,522	5,393	50.6
1904	10,873,778	5,631	51.8
1905	11,091,034	5,881	53.0
1906	11,308,290	6,136	54.3
1907	11,525,546	6,454	56.0
1908	11,742,802	6,606	56.3
1909	11,960,058	7,115	59.5
1910	12,177,315	7,626	62.6
1911	12,394,571	7,962	64.2
1912	12,611,827	8,101	64.2
1913	12,829,083	8,617	67.2
1914	13,046,339	8,915	68.3
1915	13,263,595	9,589	72.3

FEMALE.

1900	9,990,458	8,066	80.7
1901	10,186,856	8,456	83.0
1902	10,383,254	8,703	83.8
1903	10,579,652	9,257	87.5
1904	10,776,051	9,616	89.2
1905	10,972,450	10,102	92.1
1906	11,168,849	10,290	92.1
1907	11,365,248	10,870	95.6
1908	11,561,647	11,290	97.7
1909	11,758,046	11,715	99.6
1910	11,954,444	12,398	103.7
1911	12,150,842	12,634	104.0
1912	12,347,240	13,350	108.1
1913	12,543,638	13,880	110.7
1914	12,740,037	14,052	110.3
1915	12,936,437	14,472	111.9

(a) Figures from a manuscript table kindly furnished the writer by the Bureau of the Census.
(b) Maine, New Hampshire, Vermont, Massachusetts, Rhode Island, Connecticut, New York, New Jersey, District of Columbia, Indiana, and Michigan.

TABLE III. (a)

DEATH RATE FROM CANCER CLASSIFIED BY SEX, FOR FOURTEEN AMERICAN CITIES, (b) BY FIVE YEAR PERIODS, 1891–1910.

Period.	Population.	Deaths from Cancer.	Death Rate per 100,000 Population.
	MALE.		
1891–1895	12,805,336	5,050	39.4
1896–1900	16,461,766	7,543	45.8
1901–1905	20,382,334	10,631	52.1
1906–1910	23,045,672	14,245	61.8
	FEMALE.		
1891–1895	13,255,922	9,535	71.9
1896–1900	16,962,809	13,173	77.7
1901–1905	20,851,575	17,885	85.8
1906–1910	23,409,743	22,345	95.5

(a) Data from *Hoffman*, pp. 475, ff. The figures for New York City speak for Greater New York since 1898 and for Manhattan and Bronx Boroughs before that date. The cancer mortality of Brooklyn by sex 1891–1898 is unknown.
(b) Augusta, Ga., Boston, Cincinnati, Cleveland, Hartford, Nashville, New Haven, New York City, Philadelphia, Providence, Richmond, Springfield, Mass., St. Louis, Washington.

TABLE IV. (a)

DEATH RATE FROM CANCER CLASSIFIED BY SEX, FOR ENGLAND AND WALES, IRELAND, NORWAY, BAVARIA, ITALY, NEW SOUTH WALES, VICTORIA, SOUTH AUSTRALIA, QUEENSLAND, TASMANIA, NEW ZEALAND, BERMUDAS, AND JAMAICA, BY FIVE YEAR PERIODS, 1896–1910.

Period.	Population.	Deaths from Cancer.	Death Rate per 100,000 Population.
	MALE.		
1896–1900	199,454,004	113,988	57.2
1901–1905	207,654,862	132,566	63.8
1906–1910	215,633,636	155,607	72.2
	FEMALE.		
1896–1900	205,838,996	158,280	76.9
1901–1905	214,802,328	178,108	82.3
1906–1910	224,589,489	200,667	89.4

(a) Data from *Hoffman*, pp. 596, ff.

TABLE V. (a)

DEATH RATE FROM CANCER CLASSIFIED BY SEX, FOR CERTAIN FOREIGN CITIES, (b) BY FIVE YEAR PERIODS, 1896–1910.

Period.	Population.	Deaths from Cancer.	Death Rate per 100,000 Population.
	MALE.		
1896–1900	34,316,038	27,581	80.4
1901–1905	36,819,660	33,243	90.3
1906–1910	39,343,588	39,118	99.4
	FEMALE.		
1896–1900	37,160,633	39,996	107.6
1901–1905	40,045,459	46,070	115.0
1906–1910	42,691,732	51,277	120.1

(a) Data from *Hoffman*, pp. 605, ff.
(b) London, Sheffield, Liverpool, Manchester, Cities of Denmark, Bremen, Berlin, Frankfort, Munich, Paris, Budapest, Sydney, Toronto, Buenos Aires.

TABLE VI. (a)

DEATHS FROM CANCER IN FRANKFORT-ON-MAIN AT ALL AGES, CLASSIFIED BY PART OF BODY AFFECTED.

Part of Body Affected.	1860–1866		1867–1873		1874–1880		1881–1887		1888–1893(b)		1894–1899(c)		1900–1904		1905–1909		1910–1913		Total.		
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Both.
Position undefined	33	29	18	30	42	20	58	55	31	32	26	29	26	38	42	74	42	63	318	370	688
Nervous system	5	3	8	5	4	1	10	10	2	4	3	3	4	6		1	2	2	38	35	73
Heart		1													3				3	1	4
Respiratory organs	2	3	2	1	8	4	8	3	8	12	20	11	29	13	39	36	31	23	147	106	253
Tongue	4		4		1	4	7	1	10	1	10	2	8	1	12		13	4	69	13	82
Esophagus and pharynx	6	2	5	3	15	4	30	11	41	4	62	10	69	17	87	15	51	16	366	82	448
Stomach	36	55	46	58	80	73	104	121	110	108	136	147	212	196	227	263	261	248	1212	1269	2481
Intestines	19	17	18	29	38	37	22	57	54	45	73	48	91	93	135	136	137	93	587	555	1142
Intra and retro-peritoneal	5	5	6	16	9	18	9	20	11	22	12	36	8	31	11	31	6	25	77	204	281
Liver	23	27	36	40	51	57	67	72	33	73	50	106	64	108	88	127	68	128	480	738	1218
Pancreas and spleen		1	1	1	4	1	1	4	1	4	5	3	9	11	8	9	5	4	34	38	72
Kidneys	1	1	4	2	4	2	7	3	7	1	9	3	6	3	10	5	5	8	53	28	81
Prostate, urinary bladder and penis	7	1	10	4	7	1	14	5	9	5	24	17	33	9	30	11	34	20	168	73	241
Uterus		69		96		117		159		158		148		182		206		161		1296	1296
Ovaries		9		9		17		20		30		14		8		14		13		134	134
Mamma		43		42		60		41	1	63		55		72		83	1	101	2	560	562
Vagina		1		2		5		5		5		4		2		3		20		47	47
Bone	2		2		5	1	5	1	4	4	13	11	13	13	16	23	12	14	72	67	139
Total	143	267	160	338	268	422	342	588	322	571	443	647	572	803	708	1037	668	943	3626	5616	9242

(a) Figures from 1860 to 1887, inclusive, derived from *King and Newsholme*, Table XIII. Figures for later years derived from manuscript tables from the Frankfort Statistical Office.
(b) Omitting the year 1890, for which the figures were not available.
(c) Omitting the year 1896, for the above reason.

TABLE VII. (a)

DEATHS FROM CANCER IN FRANKFORT-ON-MAIN OVER TWENTY YEARS OF AGE.

Age.	1860–1866		1867–1873		1874–1880		1881–1887		1888–1893 (b)	
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.
20–29	3	5	5	3	7	5	6	15	1	9
30–39	10	13	17	32	19	40	34	50	15	53
40–49	18	51	20	65	47	92	57	123	66	101
50–59	50	86	40	95	60	112	94	143	106	166
60–69	36	70	47	80	79	99	88	151	80	153
70–79	19	35	26	54	43	67	46	75	47	66
80+	4	4	3	5	5	5	5	20	6	17
Total.....	140	264	158	334	260	420	330	577	321	565

Age.	1894–1899 (c)		1900–1904		1905–1909		1910–1913		Total.		
	Males.	Females.	Males.	Females	Males.	Females.	Males.	Females.	Males.	Females.	Both.
20–29	8	5	9	13	12	12	11	9	62	76	138
30–39	26	48	41	59	25	55	41	70	228	420	648
40–49	68	130	73	130	88	179	99	160	536	1,031	1,567
50–59	138	188	148	238	208	284	145	246	989	1,558	2,547
60–69	123	175	189	215	255	298	238	260	1,135	1,501	2,636
70–79	62	84	90	121	95	166	118	158	546	826	1,372
80+	10	14	17	25	15	34	7	32	72	156	228
Total	435	644	567	801	698	1,028	659	935	3,568	5,568	9,136

(a) Figures from 1860 to 1887, inclusive, derived from *King and Newsholme*, Table XIV. Figures for later years derived from manuscript tables from the Frankfort Statistical Office.
(b) Omitting the year 1890, for which the figures were not available.
(c) Omitting the year 1896, for which the figures were not available.

TABLE VIII. (a)

DEATHS FROM CANCER IN FRANKFORT-ON-MAIN OVER TWENTY YEARS OF AGE CLASSIFIED INTO ACCESSIBLE CANCER, INACCESSIBLE CANCER AND CANCER IN UNDEFINED POSITION.

Age.	1860–1866		1867–1873		1874–1880		1881–1887		1888–1893 (b)		1894–1899 (c)		1900–1904		1905–1909		1910–1913		Total.		
	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Males.	Females.	Both.
Accessible Cancer.																					
20–29		1				4				1			1	5		4		4	1	19	20
30–39		6	1	19		21	1	26	1	30		20		29		27		30	3	208	211
40–49		36	2	28		53	4	63	7	55	4	53	1	59	5	70	5	78	28	495	523
50–59	6	40		51		51	1	62	4	71	7	71	5	87	6	96	7	69	36	598	634
60–69	3	26	6	30		46		34	2	53	3	48	2	58	5	72	6	71	27	437	464
70–79		7		14	1	14	1	13	1	15		15	2	22	2	27	4	33	11	160	171
80+	1			1		1		4		4		4		6		9	2	10	3	39	42
Total...	10	115	9	143	1	186	7	206	15	229	14	211	11	266	18	305	24	295	109	1956	2065

INACCESSIBLE CANCER.

20–29	1	4	3	3	6	5	1	10		8	6	5	8	7	11	7	10	4	46	53	99
30–39	4	6	13	11	17	15	21	21	11	20	22	27	39	26	23	25	37	32	187	183	370
40–49	14	9	15	33	40	36	44	46	51	41	63	72	67	66	77	96	89	70	460	469	929
50–59	34	36	35	34	50	54	80	64	93	91	122	108	141	146	191	167	134	164	880	864	1744
60–69	27	39	38	44	71	50	78	104	75	94	118	117	182	151	242	212	224	175	1055	986	2041
70–79	16	23	25	36	32	50	42	59	43	45	59	67	84	93	89	133	107	120	497	626	1123
80+	1	4	3	3	4	4	3	14	6	11	10	10	15	17	15	24	4	22	61	109	170
Total..	97	121	132	164	220	214	269	318	279	310	400	406	536	506	648	664	605	587	3186	3290	6476

CANCER, POSITION UNDEFINED.

20–29	2		2		1		5	1	1		2			1	1	1	1	1	15	4	19
30–39	6	1	3	2	2	4	12	3	3	3	4	1	2	4	2	3	4	8	38	29	67
40–49	4	6	3	4	7	3	9	14	8	5	1	5	5	5	6	13	5	12	48	67	115
50–59	10	10	5	10	10	7	13	17	9	4	9	9	2	5	11	21	4	13	73	96	169
60–69	6	6	3	6	8	3	10	13	3	6	2	10	5	6	8	14	8	14	53	78	131
70–79	3	5	1	4	10	3	3	3	3	6	3	2	4	6	4	6	7	5	38	40	78
80+	2			1	1		2	2		2			2	2		1	1		8	8	16
Total...	33	28	17	27	39	20	54	53	27	26	21	27	20	29	32	59	30	53	273	322	595

(a) Figures from 1860 to 1887, inclusive, derived from *King and Newsholme*, Table XIV continued. Figures for later years derived from manuscript tables from the Frankfort Statistical Office.
(b) Omitting the year 1890, for which the figures were not available.
(c) Omitting the year 1896, for the same reason.

TABLE IX. (a)

POPULATION AT RISK IN FRANKFORT-ON-MAIN.

Age.	1860–1866	1867–1873	1874–1880	1881–1887	1888–1893 (b)	1894–1899 (c)	1900–1904	1905–1909	1910–1913
					MALES.				
20–29	90,404	76,174	90,222	96,183	97,888	134,459	173,683	192,245	169,211
30–39	42,294	49,166	69,410	87,654	70,964	93,702	124,430	154,841	158,092
40–49	29,201	30,964	40,993	57,471	51,794	65,878	77,958	93,107	97,586
50–59	18,924	30,036	23,860	30,224	29,154	41,070	51,297	57,152	53,499
60–69	10,850	11,556	12,918	16,158	13,586	18,124	24,008	29,540	29,912
70–79	3,700	4,228	5,116	6,292	5,109	6,506	7,898	9,240	9,984
80+	617	750	919	1,137	842	1,091	1,319	1,454	1,381
Total...	195,990	192,874	243,438	295,119	269,337	360,830	460,593	537,579	519,665
					FEMALES.				
20–29	74,536	85,365	108,009	133,871	119,057	157,951	193,103	213,162	192,782
30–39	40,880	50,361	70,137	91,459	76,921	99,789	126,516	154,969	156,157
40–49	27,260	31,019	41,705	60,116	54,239	69,218	82,207	97,156	98,545
50–59	19,645	21,320	26,813	34,575	33,308	46,071	56,964	64,094	61,067
60–69	12,172	13,881	16,524	21,439	18,143	24,286	31,934	38,166	37,998
70–79	4,272	5,288	7,008	8,957	7,774	9,975	11,951	14,077	14,508
80+	1,110	944	1,077	1,904	1,632	1,879	2,296	2,630	2,490
Total. .	179,875	208,178	271,273	352,321	311,074	409,169	504,971	584,254	563,547

(a) Figures from 1860 to 1887, inclusive, derived from *King and Newsholme*, Table XV. Figures for later years derived from German census report.
(b) Omitting the year 1890, for which the figures were not available.
(c) Omitting the year 1896, for which the figures were not available.

TABLE X. (a)

FRANKFORT. ANNUAL DEATHS FROM CANCER IN 1,000,000 LIVING, AT LEAST TWENTY-FIVE YEARS OF AGE. POPULATION DISTRIBUTED IN AGE GROUPS ACCORDING TO ENGLISH LIFE TABLE NO. 3—PERSONS.

Period.	Accessible.	Inaccessible.	Position Undefined.	Total.
		MALES.		
1860–1866	126	1,118	359	1,603
1867–1873	88	1,421	137	1,646
1874–1880	14	1,913	363	2,290
1881–1887	35	1,865	305	2,205
1888–1893 (b)	91	2,289	171	2,551
1894–1899 (c)	66	2,489	104	2,659
1900–1904	51	2,742	118	2,911
1905–1909	68	2,791	119	2,981
1910–1913	119	2,522	130	2,771
		FEMALES.		
1860–1866	1,081	1,323	293	2,697
1867–1873	1,214	1,540	254	3,008
1874–1880	1,220	1,588	131	2,939
1881–1887	981	1,820	272	3,073
1888–1893 (b)	1,275	1,959	174	3,408
1894–1899 (c)	903	1,936	122	2,961
1900–1904	914	2,013	115	3,042
1905–1909	925	2,311	180	3,416
1910–1913	913	2,057	152	3,122

(a) Figures from 1860 to 1887, inclusive, derived from *King and Newsholme*, Table XVI. Figures for later years derived from manuscript tables from the Frankfort Statistical Office.
(b) Omitting the year 1890, for which the figures were not available.
(c) Omitting the year 1896, for which the figures were not available.

TABLE XI.

STANDARD MILLION, ENGLAND AND WALES, AS SHOWN BY ENGLISH LIFE TABLE NO. 3 AND BY CENSUS OF 1881.

Age Period.	English Life Table No. 3.	Census of 1881.
	MALES.	
Under 5	49,630	67,669
5–9	42,710	60,389
10–14	41,210	53,985
15–19	40,150	48,828
20–24	38,700	42,825
25–29	36,980	37,238
30–34	35,190	32,890
35–39	33,300	29,095
40–44	31,250	25,493
45–49	28,990	21,640
50–54	26,430	18,140
55–59	23,470	15,550
60–64	20,070	12,268
65–69	16,110	8,946
70–74	11,670	6,064
75–79	7,230	3,541
80–84	3,590	1,503
85–89	1,320	448
90–94	330	101
95+	50	15
	488,380	486,628

FEMALES.

Under 5	51,000	67,882
5-9	44,320	60,783
10-14	42,740	53,826
15-19	41,570	49,239
20-24	39,990	46,810
25-29	38,140	40,465
30-34	36,210	35,455
35-39	34,190	31,190
40-44	32,100	27,439
45-49	29,920	23,660
50-54	27,630	20,236
55-59	25,010	17,309
60-64	21,790	13,935
65-69	17,910	10,507
70-74	13,400	7,301
75-79	8,700	4,431
80-84	4,590	2,000
85-89	1,820	670
90-94	500	197
95+	90	37
	511,620	513,372

TABLE XII.

STANDARDIZED CANCER DEATH RATES FOR FRANKFORT, BASED ON ENGLISH LIFE TABLE NO. 3 AND ON ENGLISH CENSUS OF 1881.

Age.	Standard Million.		Cancer Death Rate Frankfort 1860-66. (a)	Computed Cancer Deaths.	
	English Life Table No. 3.	English Census of 1881.		English Life Table No. 3.	English Census of 1881.
			MALES.		
Under 20	173,700	230,871	2.7	5	6
20-29	75,680	80,063	3.5	3	3
30-39	68,490	61,985	20.5	14	13
40-49	60,240	47,133	53.1	32	25
50-59	49,900	33,690	225.1	112	76
60-69	36,180	21,214	278.7	101	59
70-79	18,900	9,605	453.9	86	44
80+	5,290	2,067	514.8	27	11
Total.....	488,380	486,628		380	237
			FEMALES.		
Under 20	179,630	231,730	3.0	5	7
20-29	78,130	87,275	6.0	5	5
30-39	70,400	66,645	27.0	19	18
40-49	62,020	51,099	156.2	97	80
50-59	52,640	37,545	372.4	196	140
60-69	39,700	24,442	477.8	190	117
70-79	22,100	11,732	693.5	153	81
80+	7,000	2,904	332.3	23	10
Total.....	511,620	513,372		688	458
Both sexes...	1,000,000	1,000,000		1,068	695

(a) Computed, using census population of Frankfort, 1864, from *Stat. d. deut. Reichs*, "Beiträge zur Statistik d. St. Frankfurt-am-Main," II (1866), pt. I, Table XIX, and deaths from *King and Newsholme*, p. 240, supplemented as to deaths under 20 from personal investigation.

TABLE XIII.

STANDARDIZED CANCER DEATH RATES FOR FRANKFORT, 1888-89, BASED ON ENGLISH LIFE TABLE NO. 3 AND ON ENGLISH CENSUS OF 1881.

Age.	Standard Million.		Cancer Death Rate per 100,000 Population, Frankfort, 1888-89. (a)	Computed Cancer Deaths.	
	English Life Table No. 3	English Census of 1881.		English Life Table No. 3.	English Census of 1881.
Males.					
Under 20	173,700	230,871			
20-29	75,680	80,063	2.7	2	2
30-39	68,490	61,985	14.8	10	9
40-49	60,240	47,133	132.6	80	62
50-59	49,900	33,690	362.0	180	122
60-69	36,180	21,214	466.2	169	99
70-79	18,900	9,605	821.4	155	79
80+	5,290	2,067	625.0	33	13
Total.....	488,380	486,628		629	386
Females.					
Under 20	179,630	231,730	3.0	5	7
20-29	78,130	87,275	6.7	5	6
30-39	70,400	66,645	68.6	48	46
40-49	62,020	51,099	200.0	124	102
50-59	52,640	37,545	493.4	260	185
60-69	39,700	24,442	887.1	352	217
70-79	22,100	11,732	815.8	180	96
80+	7,000	2,904	937.5	66	27
Total.....	511,620	513,372		1,040	686
Both sexes	1,000,000	1,000,000		1,669	1,072

(a) The death rates from cancer 1888-89 were computed by using the population of Frankfort December 1, 1889 (estimated by arithmetical method from population of 1885 and 1890) and the average annual deaths from cancer 1888-89, derived from *King and Newsholme*, Table XIV (this Appendix, Table VII).

TABLE XIV. (a)

DEATH RATE FROM CANCER IN THE REGISTRATION STATES OF 1900 IN THE YEARS 1900-1910.

Year.	Population.	Deaths from Cancer.	Death Rate per 100,000 Population.
1900	19,995,212	12,769	63.9
1901	20,408,866	13,438	65.8
1902	20,822,520	13,653	65.6
1903	21,236,174	14,650	69.0
1904	21,649,829	15,247	70.4
1905	22,063,484	15,983	72.4
1906	22,477,139	16,426	73.1
1907	22,890,794	17,324	75 7
1908	23,304,449	17,896	76.8
1909	23,718,104	18,830	79.4
1910	24,131,750	20,024	83.0

Increase per 100,000 population, 1900-1910.....19.1
Per cent. increase, 1900-1910.....29.9

(a) Data kindly furnished the writer in manuscript by the Bureau of the Census.

TABLE XV.

STANDARDIZED CANCER DEATH RATE 1910 IN REGISTRATION STATES AS CONSTITUTED IN 1900. (a)

Age Period.	Males.			Females.		
	Population 1900.	Cancer Death Rate per 100,000 Population 1910.	Estimated Deaths 1910.	Population 1900.	Cancer Death Rate per 100,000 Population 1910.	Estimated Deaths 1910.
Under 5	1,048,490	4.1	43	1,031,197	2.8	29
5–9	1,001,754	1.5	15	988,707	1.2	12
10–14	915,572	1.8	16	909,552	1.4	13
15–19	885,871	2.9	26	926,057	3.5	32
20–24	920,072	4.9	45	993,194	4.1	41
25–34	1,751,535	9.5	166	1,730,952	21.9	379
35–44	1,408,030	33.0	465	1,325,608	88.9	1,178
45–54	966,630	106.7	1,031	928,077	230.7	2,141
55–64	620,054	272.0	1,686	632,720	411.3	2,602
65–74	343,391	493.6	1,695	362,034	616.2	2,231
75+	143,355	693.7	994	162,360	867.8	1,400
Total.....	10,004,754		6,182	9,990,458		10,067

Total population	19,995,212
Estimated deaths	16,249
Standardized death rate	81.3

(a) Population 1900 and cancer death rates 1910 kindly furnished the writer by the Bureau of the Census.

TABLE XVI.

STANDARDIZED CANCER DEATH RATE, ENGLAND AND WALES, 1911.

Age Period.	Males.			Females.		
	Population (a) 1901.	Cancer Death Rate per 100,000 Population (b) 1911.	Estimated Deaths 1911.	Population (a) 1901.	Cancer Death Rate per 100,000 Population (b) 1911.	Estimated Deaths 1911.
Under 5	1,855,361	3.3	61	1,861,347	2.6	48
5–9	1,738,993	2.8	49	1,748,298	1.8	31
10–14	1,670,970	2.2	37	1,670,770	1.3	22
15–19	1,607,522	3.6	58	1,638,621	2.7	44
20–24	1,472,644	6.3	93	1,648,278	4.4	73
25–29	1,328,288	8.5	113	1,496,221	8.0	120
30–34	1,157,666	14.0	162	1,273,665	25.0	318
35–39	1,034,469	27.4	283	1,110,924	56.8	631
40–44	897,484	58.8	528	953,138	113.3	1,080
45–49	759,955	127.2	967	813,233	191.8	1,559
50–54	636,254	224.3	1,427	692,749	264.1	1,829
55–59	497,498	350.0	1,741	555,079	389.4	2,161
60–64	410,447	523.7	2,150	480,226	507.2	2,436
65–69	282,403	695.6	1,964	347,270	622.6	2,162
70–74	195,465	868.4	1,697	250,868	808.1	2,027
75–79	113,096	947.0	1,071	151,384	889.0	1,346
80–84	52,137	851.0	444	76,631	863.8	662
85+	17,971	738.9	133	30,528	808.4	247
Total...	15,728,613		12,978	16,799,230		16,796

Total population	32,527,843
Estimated deaths	29,774
Standardized death rate	91.5

(a) From *Census of England and Wales*, 1901, *Summary Tables*, p. 139.

(b) Computed, using population for 1911 from *Census of England and Wales, 1911*, VII, pp. 1, 2; and deaths for 1911 from *74th Ann. Rep. of Registrar-General* (1911), p. 201.

TABLE XVII.

STANDARDIZED CANCER DEATH RATE OF ENGLAND AND WALES, 1891-1900.

Age Period.	Males.			Females.		
	Standard Million 1881-1890.	Cancer Death Rate per 100,000 Population 1891-1900.	Estimated Deaths 1891-1900.	Standard Million 1881-1890.	Cancer Death Rate per 100,000 Population 1891-1900.	Estimated Deaths 1891-1900.
Under 5	64,122	3.3	2	64,557	2.8	2
5-9	59,333	1.8	1	59,673	1.4	1
10-14	54,806	1.9	1	54,765	1.4	1
15-19	49,720	3.2	2	50,287	2.7	1
20-24	42,922	5.1	2	47,564	3.9	2
25-34	71,131	9.9	7	77,499	17.5	14
35-44	55,095	38.4	21	58,944	89.1	53
45-54	40,472	130.0	53	44,478	232.3	103
55-64	27,151	316.0	86	30,893	409.9	127
65-74	15,184	532.5	81	18,326	582.9	107
75+	5,591	582.4	33	7,487	637.7	48
Total.....	485,527		289	514,473		459

Standardised death rate per 100,000..... 74.8

(a) Standard million from *Supp. to 65th Ann. Rep. of Registrar-General* (1891-1900), p. xi; average annual deaths per million, *Ibid.*, p. cxcv.

TABLE XVIII.

STANDARDIZED CANCER DEATH RATE, NEW YORK CITY, 1910.

Age Period.	Males.			Females.		
	Population 1900.	Cancer Death Rate per 100,000 Population (a) 1910.	Estimated Deaths 1910.	Population 1900.	Cancer Death Rate per 100,000 Population (a) 1910.	Estimated Deaths 1910.
Under 5	199,683	7.0	14	197,604	2.8	6
5-9	177,591	0.9	2	177,156	2.3	4
10-14	149,906	1.4	2	151,358	1.4	2
15-19	140,670	4.1	6	162,081	3.3	5
20-24	161,988	9.9	16	192,853	2.8	5
25-34	343,178	12.4	43	338,175	26.4	89
35-44	261,095	44.3	116	232,950	107.9	251
45-54	146,495	172.9	253	141,837	281.4	399
55-64	78,692	398.4	314	82,591	497.9	411
65-74	32,915	733.2	241	39,314	665.0	261
75+	9,799	681.4	67	13,835	884.6	122
Total.....	1,702,012		1,074	1,729,754		1,555

Total population..... 3,431,766
Estimated deaths..... 2,629
Standardised death rate..... 76.6

(a) Death rates kindly furnished in manuscript by Bureau of the Census.

TABLE XIX.

STANDARDIZED CANCER DEATH RATE, LONDON, (a) 1911.

Age Period.	Males.			Females.		
	Population 1901. (b)	Cancer Death Rate per 100,000 Population (c) 1911.	Estimated Deaths 1911.	Population 1901. (b)	Cancer Death Rate per 100,000 Population (c) 1911.	Estimated Deaths 1911.
Under 15	675,970	3.5	24	681,904	2.3	16
15–24	426,271	5.5	23	493,478	3.8	19
25–34	371,418	11.8	44	437,763	16.0	70
35–39	150,706	30.4	46	168,882	60.2	102
40–44	129,992	64.0	83	141,486	128.0	181
45–49	107,320	164.9	177	119,010	170.5	203
50–54	87,913	279.5	246	99,284	268.1	266
55–59	65,784	439.3	289	75,821	392.5	298
60–64	52,932	664.3	352	65,153	508.2	331
65–69	33,341	855.0	285	45,125	591.9	267
70–74	21,662	1,130.3	245	32,647	764.7	250
75–79	11,816	1,104.1	130	19,612	942.7	185
80–84	5,218	993.6	52	10,200	963.6	98
85+	1,742	624.2	11	4,091	997.3	41
Total.....	2,142,085		2,007	2,394,456		2,327

Total population..... 4,536,541
Estimated deaths..... 4,334
Standardised death rate..... 95.5

(a) Administrative, or Registration, County.
(b) From *Census of England and Wales, 1911, Summary Tables*, pp. 148–149.
(c) From *74th Ann. Rep. of Registrar-General* (1901), p. lxxvi.

TABLE XX. (a)

DEATH RATES FROM CANCER IN VARIOUS EUROPEAN COUNTRIES AND THE AUSTRALIAN COLONIES.

Year.	Death Rate from Cancer per 100,000 Population.	Year.	Death Rate from Cancer per 100,000 Population.	Year.	Death Rate from Cancer per 100,000 Population.	Year.	Death Rate from Cancer per 100,000 Population.
			England and Wales. (b)				
1858	32.9	1872	43.1	1886	59.0	1900	83.9
1859	33.7	1873	44.4	1887	61.5	1901	84.3
1860	34.1	1874	46.1	1888	62.2	1902	84.6
1861	36.0	1875	47.1	1889	65.6	1903	87.4
1862	36.1	1876	47.3	1890	67.6	1904	88.2
1863	36.1	1877	48.8	1891	69.2	1905	88.9
1864	38.6	1878	50.3	1892	69.2	1906	92.2
1865	37.2	1879	50.1	1893	71.0	1907	91.5
1866	38.5	1880	51.4	1894	71.2	1908	93.3
1867	39.2	1881	52.0	1895	75.3	1909	96.1
1868	40.3	1882	53.4	1896	76.4	1910	96.7
1869	41.7	1883	54.9	1897	78.5		
1870	42.4	1884	56.5	1898	79.9		
1871	42.4	1885	57.2	1899	82.6		

(a) Computed from figures for population and deaths in *March*, Vols. I and II.
(b) Figures going back to 1838 may be found in the successive *Annual Reports of the Registrar-General.*

SCOTLAND.

1855	29.2	1869	43.1	1883	53.6	1897	74.7
1856	30.3	1870	41.1	1884	55.1	1898	79.5
1857	31.9	1871	42.5	1885	56.3	1899	81.3
1858	31.8	1872	45.8	1886	59.5	1900	78.9
1859	33.0	1873	44.7	1887	60.6	1901	81.8
1860	33.2	1874	47.3	1888	62.1	1902	82.3
1861	38.0	1875	47.6	1889	66.5	1903	83.8
1862	37.2	1876	47.7	1890	60.7	1904	85.9
1863	37.2	1877	48.2	1891	67.0	1905	90.0
1864	41.2	1878	50.4	1892	66.6	1906	97.6
1865	39.5	1879	49.9	1893	68.3	1907	97.9
1866	41.3	1880	50.5	1894	70.3	1908	98.5
1867	39.7	1881	51.1	1895	71.1	1909	101.6
1868	40.5	1882	54.5	1896	70.8	1910	102.7

IRELAND.

1864	26.6	1876	32.2	1888	41.7	1900	60.8
1865	28.6	1877	35.4	1889	44.9	1901	65.1
1866	30.7	1878	36.2	1890	45.5	1902	64.5
1867	30.2	1879	33.9	1891	46.2	1903	69.0
1868	30.1	1880	34.1	1892	47.9	1904	69.4
1869	30.5	1881	37.1	1893	49.5	1905	74.9
1870	33.1	1882	36.9	1894	51.8	1906	79.2
1871	32.1	1883	39.7	1895	50.4	1907	76.2
1872	32.6	1884	39.1	1896	53.7	1908	75.7
1873	32.7	1885	39.0	1897	58.2	1909	80.0
1874	33.4	1886	41.4	1898	58.8	1910	83.7
1875	33.2	1887	42.6	1899	59.0		

NORWAY.

1870	27.1	1881	45.7	1891	61.3	1901	95.1
1871	27.3	1882	46.2	1892	63.7	1902	91.5
1872	27.0	1883	49.4	1893	69.7	1903	93.2
1873	34.5	1884	51.6	1894	71.4	1904	96.0
1874	31.9	1885	53.1	1895	71.2	1905	98.4
1875	34.6	1886	50.4	1896	81.1	1906	97.6
1876	34.4	1887	55.6	1897	85.4	1907	100.3
1877	37.1	1888	55.2	1898	84.2	1908	97.2
1878	37.6	1889	56.4	1899	89.1	1909	95.2
1879	41.8	1890	57.0	1900	91.3	1910	92.9
1880	41.4						

AUSTRIA.

1873	33.0	1883	44.4	1893	59.0	1902	74.2
1874	33.9	1884	45.7	1894	60.8	1903	73.7
1875	35.2	1885	47.6	1895	63.7	1904	74.9
1876	36.4	1886	48.3	1896	65.8	1905	76.2
1877	37.4	1887	47.8	1897	67.9	1906	77.9
1878	38.4	1888	49.3	1898	69.4	1907	77.3
1879	40.7	1889	51.6	1899	69.9	1908	78.0
1880	40.7	1890	52.6	1900	70.9	1909	78.7
1881	42.2	1891	54.3	1901	72.9	1910	77.9
1882	42.7	1892	57.0				

SWITZERLAND.

1877	78.9	1886	111.5	1895	122.2	1903	129.7
1878	82.4	1887	110.4	1896	120.0	1904	128.6
1879	86.6	1888	113.8	1897	123.4	1905	127.4
1880	90.7	1889	111.7	1898	123.3	1906	129.1
1881	99.3	1890	111.8	1899	122.0	1907	122.5
1882	99.1	1891	114.4	1900	125.4	1908	128.0
1883	101.0	1892	119.8	1901	127.9	1909	126.7
1884	103.9	1893	116.0	1902	125.8	1910	123.5
1885	106.5	1894	116.2				

GERMAN EMPIRE. (a)

1892	61.0	1897	69.3	1902	75.0	1907	83.2
1893	63.0	1898	70.4	1903	77.2	1908	83.7
1894	64.5	1899	73.7	1904	79.8	1909	84.5
1895	65.7	1900	72.1	1905	80.9	1910	87.9
1896	68.1	1901	74.7	1906	81.3		

PRUSSIA.

1875	22.9	1884	35.3	1893	51.1	1902	61.9
1876	24.2	1885	35.8	1894	52.8	1903	65.2
1877	26.5	1886	38.3	1895	53.2	1904	68.6
1878	28.2	1887	38.1	1896	54.8	1905	69.4
1879	28.8	1888	40.9	1897	56.0	1906	70.4
1880	29.9	1889	43.5	1898	56.3	1907	73.4
1881	31.1	1890	43.3	1899	59.3	1908	73.6
1882	31.9	1891	44.7	1900	59.6	1909	74.8
1883	33.8	1892	49.6	1901	61.7	1910	78.5

BAVARIA.

1888	79.4	1894	92.6	1900	99.3	1906	110.5
1889	81.6	1895	94.9	1901	102.9	1907	106.8
1890	81.0	1896	95.3	1902	103.4	1908	108.2
1891	88.7	1897	96.9	1903	107.4	1909	109.7
1892	85.0	1898	97.3	1904	110.2	1910	114.2
1893	90.0	1899	101.9	1905	108.9		

SAXONY. (b)

1892	85.7	1897	95.2	1902	97.0	1907	97.3
1893	85.7	1898	91.2	1903	91.0	1908	94.3
1894	89.1	1899	94.8	1904	88.2	1909	93.9
1895	89.5	1900	93.6	1905	91.6	1910	93.9
1896	93.2	1901	97.4	1906	93.8		

WURTEMBERG.

1892	71.4	1897	80.0	1902	97.4	1907	102.8
1893	71.4	1898	95.0	1903	98.4	1908	102.9
1894	70.7	1899	94.0	1904	98.7	1909	105.5
1895	75.2	1900	94.0	1905	104.2	1910	107.3
1896	82.1	1901	94.4	1906	99.3		

HOLLAND.

1875	47.9	1884	61.6	1893	80.8	1902	95.0
1876	48.5	1885	66.0	1894	81.0	1903	98.9
1877	50.2	1886	67.0	1895	85.4	1904	97.9
1878	51.1	1887	65.3	1896	88.5	1905	101.2
1879	52.5	1888	69.5	1897	90.4	1906	100.7
1880	54.4	1889	75.3	1898	93.0	1907	101.8
1881	57.6	1890	73.4	1899	96.0	1908	102.8
1882	58.4	1891	79.4	1900	91.8	1909	102.6
1883	58.0	1892	79.9	1901	93.7	1910	106.4

(a) Figures include about 94 per cent. of the population. For details see notes in *March*, I and II.
(b) For figures running back to 1873 see *Zeitschr. d. k. Sächs. Stat. Landesamtes* 1905, p. 263.

SPAIN.

1900	39.3	1903	44.1	1906	47.6	1909	51.0
1901	42.4	1904	46.6	1907	47.5	1910	52.3
1902	43.3	1905	45.8	1908	51.4		

ITALY.

1887	42.7	1893	42.9	1899	51.9	1905	58.3
1888	42.3	1894	44.5	1900	52.2	1906	62.0
1889	43.0	1895	48.2	1901	52.7	1907	61.7
1890	42.7	1896	49.1	1902	53.9	1908	64.5
1891	43.0	1897	50.3	1903	53.8	1909	64.2
1892	42.6	1898	51.1	1904	57.1	1910	65.6

SERBIA.

1895	5.5	1899	9.5	1903	9.1	1907	13.3
1896	6.6	1900	9.5	1904	10.3	1908	12.6
1897	7.0	1901	9.1	1905	10.4	1909	13.1
1898	7.4	1902	9.6	1906	10.6	1910	12.8

NEW SOUTH WALES.

1875	30.9	1884	26.4	1893	40.7	1902	62.3
1876	27.5	1885	28.8	1894	42.1	1903	65.4
1877	26.6	1886	34.4	1895	44.4	1904	66.0
1878	29.0	1887	35.2	1896	48.9	1905	65.3
1879	24.7	1888	39.0	1897	53.3	1906	69.0
1880	32.8	1889	36.9	1898	54.4	1907	70.8
1881	28.2	1890	35.6	1899	57.1	1908	67.5
1882	26.9	1891	45.2	1900	56.5	1909	72.5
1883	25.7	1892	43.3	1901	61.7	1910	71.7

VICTORIA.

1864	21.7	1876	38.0	1888	49.4	1900	68.5
1865	24.7	1877	40.7	1889	57.7	1901	73.4
1866	18.4	1878	38.3	1890	56.0	1902	70.4
1867	18.6	1879	45.9	1891	60.9	1903	76.1
1868	27.6	1880	45.1	1892	58.8	1904	73.9
1869	26.8	1881	40.4	1893	62.6	1905	78.6
1870	30.0	1882	41.9	1894	63.1	1906	75.5
1871	26.2	1883	49.5	1895	64.2	1907	82.1
1872	30.0	1884	47.8	1896	66.7	1908	81.8
1873	32.6	1885	46.5	1897	65.5	1909	82.6
1874	34.5	1886	50.4	1898	73.1	1910	82.5
1875	39.1	1887	51.8	1899	71.0		

QUEENSLAND.

1880	23.0	1888	23.3	1896	39.3	1904	57.2
1881	29.4	1889	32.7	1897	39.1	1905	66.7
1882	22.7	1890	28.2	1898	46.5	1906	54.7
1883	26.1	1891	33.1	1899	47.8	1907	66.4
1884	31.4	1892	31.3	1900	47.7	1908	61.0
1885	16.7	1893	28.3	1901	55.0	1909	60.7
1886	27.6	1894	35.8	1902	55.0	1910	67.3
1887	22.8	1895	41.7	1903	49.1		

SOUTH AUSTRALIA.

1880	28.1	1888	37.8	1896	52.5	1904	63.4
1881	32.6	1889	43.1	1897	51.8	1905	69.2
1882	31.0	1890	41.4	1898	51.1	1906	76.9
1883	29.2	1891	49.1	1899	57.0	1907	74.5
1884	35.9	1892	45.5	1900	59.8	1908	73.6
1885	32.8	1893	50.9	1901	60.5	1909	80.0
1886	34.1	1894	47.0	1902	75.0	1910	80.7
1887	36.0	1895	47.4	1903	73.5		

WEST AUSTRALIA.

1895	27.2	1899	35.5	1903	41.6	1907	50.0
1896	25.2	1900	29.7	1904	44.3	1908	54.3
1897	34.0	1901	44.4	1905	50.8	1909	68.0
1898	33.3	1902	41.3	1906	59.2	1910	49.5

TASMANIA.

1895	48.7	1899	53.2	1903	56.2	1907	62.9
1896	60.1	1900	53.8	1904	52.0	1908	67.6
1897	50.0	1901	54.6	1905	54.2	1909	67.4
1898	59.3	1902	61.9	1906	51.9	1910	66.5

NEW ZEALAND.

1880	28.1	1888	43.5	1896	55.1	1904	67.6
1881	27.2	1889	42.5	1897	54.7	1905	65.1
1882	28.9	1890	47.5	1898	64.0	1906	69.5
1883	29.9	1891	46.8	1899	62.4	1907	73.5
1884	34.5	1892	47.8	1900	56.3	1908	70.8
1885	31.1	1893	50.2	1901	66.2	1909	74.1
1886	36.8	1894	60.1	1902	67.2	1910	76.1
1887	39.9	1895	55.4	1903	71.0		

TABLE XXI. (a)

PROPORTION OF TOTAL DEATHS OCCURRING IN HOSPITALS, NEW YORK CITY, 1898–1915.

Year.	Total Deaths.	Deaths in Hospitals.	Per Cent. Occurring in Hospitals.
1898	66,294	10,799	16.3
1899	65,343	11,749	18.0
1900	70,872	12,609	17.8
1901	70,720	13,343	18.9
1902	68,112	12,613	18.5
1903	67,864	14,695	21.6
1904	78,060	17,138	22.0
1905	73,714	18,103	24.6
1906	76,203	19,163	25.1
1907	79,205	21,444	27.1
1908	73,072	20,684	28.3
1909	74,105	21,451	28.9
1910	76,742	22,631	29.5
1911	75,423	23,466	31.1
1912	73,008	22,198	30.4
1913	73,902	22,788	30.8
1914	74,803	23,823	31.8
1915	76,193	25,095	32.9

(a) Figures kindly furnished the writer by the Bureau of Records, New York City. Hospitals, as here used, include only those institutions "which individuals enter direct from their homes," and not those "of which decedents were residents at the time of death."

TABLE XXII. (a)

PROPORTION OF DEATHS IN HOSPITALS TO TOTAL DEATHS, FORMER CITY OF NEW YORK, 1889–1897.

Year.	Total Deaths.	Deaths in Hospitals.	Per Cent. of Deaths Occurring in Hospitals.
1889	39,583	6,102	15.4
1890	40,103	6,310	15.7
1891	43,659	6,948	15.9
1892	44,329	7,681	17.3
1893	44,486	8,306	18.7
1894	41,175	7,742	18.8
1895	43,420	8,091	18.6
1896	41,622	8,530	20.4
1897	38,857	8,534	22.0

(a) Data derived from the successive *Annual Reports of the New York City Department of Health.*

TABLE XXIII. (a)

HOSPITAL BEDS TO 100,000 POPULATION, GERMAN EMPIRE, 1877–1910.

Year.	Hospital Beds per 100,000 Population.	Year.	Hospital Beds per 100,000 Population.
1877	166	1902	325
1879	175	1903	335
1882	182	1904	345
1885	201	1905	356
1888	224	1906	364
1891	246	1907	376
1894	266	1908	382
1897	273	1909	391
1900	295	1910	400
1901	310		

(a) Computed from *Stat. Jahrb. für d. D. Reich*, XXXVI (1915), population p. 2; hospital statistics p. 440.

TABLE XXIV.

PROPORTION OF DEATHS FROM CANCER AND FROM TUMOR TO DEATHS FROM BOTH CAUSES, UNITED STATES, 1880–1914.

Year.	Deaths from			Per Cent. Cancer.	Per Cent. Tumor.
	Cancer and Tumor.	Cancer.	Tumor.		
UNITED STATES (ENTIRE AREA).					
1880	14,849	13,068	1,781	88.0	12.0
1890	20,984	18,536	2,448	88.3	11.7
1900	32,902	29,475	3,427	89.6	10.4

UNITED STATES (REGISTRATION AREA). (a)

1900	19,962	19,381	581	97.1	2.9
1901	20,676	20,171	505	97.5	2.5
1902	21,306	20,847	459	97.8	2.2
1903	22,856	22,325	531	97.7	2.3
1904	23,839	23,395	444	98.1	1.9
1900–1904	108,639	106,119	2,520	97.7	2.3
1905	24,831	24,330	501	98.0	2.0
1906	29,490	29,020	470	98.4	1.6
1907	31,022	30,514	508	98.4	1.6
1908	33,923	33,465	458	98.6	1.4
1909	38,020	37,562	458	98.8	1.2
1905–1909	157,286	154,891	2,395	98.5	1.5
1910	41,592	41,039	553	98.7	1.3
1911	44,479	44,024	455	99.0	1.0
1912	46,908	46,531	377	99.2	0.8
1913	50,225	49,928	297	99.4	0.6
1914	52,756	52,420	336	99.4	0.6
1910–1914	235,960	233,942	2,018	99.1	0.9

(a) See comments, pp. 734–735.

TABLE XXV. (a)

DEATH RATES FROM CANCER AND FROM TUMOR IN THE REGISTRATION STATES OF 1900, FOR THE YEARS 1900–1915.

Year.	Population.	Deaths from			Death Rate per 100,000 Population.			Per Cent. of Deaths from Cancer.
		Cancer.	Tumor.	Both.	Cancer.	Tumor.	Both.	
1900	19,995,212	12,769	394	13,163	63.9	2.0	65.9	97.0
1901	20,408,866	13,438	332	13,770	65.8	1.6	67.4	97.6
1902	20,822,520	13,653	287	13,940	65.6	1.4	67.0	97.9
1903	21,236,174	14,650	355	15,005	69.0	1.7	70.7	97.6
1904	21,649,829	15,247	294	15,541	70.4	1.4	71.8	98.1
1905	22,063,484	15,983	318	16,301	72.4	1.4	73.8	98.1
1906	22,477,139	16,426	284	16,710	73.1	1.3	74.4	98.3
1907	22,890,794	17,324	278	17,602	75.7	1.2	76.9	98.5
1908	23,304,449	17,896	229	18,125	76.8	1.0	77.8	98.7
1909	23,718,104	18,830	227	19,057	79.4	1.0	80.4	98.8
1910	24,131,759	20,024	294	20,318	83.0	1.2	84.2	98.6
1911	24,545,413	20,596	203	20,799	83.9	0.8	84.7	99.1
1912	24,959,067	21,451	169	21,620	85.9	0.7	86.6	99.2
1913	25,372,721	22,497	119	22,616	88.7	0.5	89.2	99.4
1914	25,786,376	22,967	144	23,111	89.1	0.6	89.7	99.3
1915	26,200,032	24,061	138	24,199	91.8	0.5	92.3	99.4

(a) Population, deaths and death rates from cancer kindly furnished the writer in manuscript by the Bureau of the Census; figures for tumor compiled from successive volumes of *Mortality Statistics*.

TABLE XXVI. (a)

DEATH RATES FROM CANCER AND FROM TUMOR, MASSACHUSETTS, BY QUINQUENNIAL PERIODS, 1853–1912.

Period.	Mid-period Census Population.	Average Annual Number of Deaths from			Death Rates per 100,000 Population.			Per Cent. of Deaths from Cancer.
		Cancer.	Tumor.	Both.	Cancer.	Tumor.	Both.	
1853–1857	1,132,369	219	60	279	19.3	5.3	24.6	78.5
1858–1862	1,231,066	317	61	378	25.8	4.9	30.7	83.9
1863–1867	1,267,031	376	67	443	29.7	5.3	35.0	84.9
1868–1872	1,457,351	509	84	593	34.9	5.8	40.7	85.8
1873–1877	1,651,912	618	90	708	37.4	5.4	42.8	87.3
1878–1882	1,783,085	907	68	975	50.8	3.8	54.6	93.0
1883–1887	1,942,141	1,090	64	1,154	56.1	3.3	59.4	94.5
1888–1892	2,238,943	1,357	70	1,427	60.6	3.1	63.7	95.1
1893–1897	2,500,183	1,677	95	1,772	67.1	3.8	70.9	94.6
1898–1902	2,805,346	1,993	85	2,078	71.0	3.0	74.0	96.0
1903–1907	3,003,680	2,502	76	2,578	83.3	2.5	85.8	97.1
1908–1912	3,366,416	3,039	42	3,081	90.2	1.2	91.4	98.6

(a) Population from federal and state censuses; deaths from cancer and tumor from successive state Registration Reports.

TABLE XXVII. (a)

DEATH RATES FROM OLD AGE IN THE REGISTRATION STATES OF 1900, FOR THE YEARS 1900–1915.

Year.	Population.	Deaths from Old Age.	Death Rates from Old Age per 100,000 Population.
1900	19,995,212	10,015	50.1
1901	20,408,856	9,771	47.9
1902	20,822,520	9,309	44.7
1903	21,236,174	8,604	40.5
1904	21,649,829	8,702	40.2
1905	22,063,484	8,251	37.4
1906	22,477,139	8,432	37.5
1907	22,890,794	7,614	33.3
1908	23,304,449	6,943	29.8
1909	23,718,104	6,472	27.3
1910	24,131,759	6,321	26.2
1911	24,545,413	6,070	24.7
1912	24,959,067	6,426	25.8
1913	25,372,721	5,795	22.8
1914	25,786,376	4,901	19.0
1915	26,200,032	4,380	16.7

(a) Population figures from manuscript table kindly furnished by the Bureau of the Census; deaths from old age from the successive volumes of *Mortality Statistics*.

TABLE XXVIII. (a)

DEATH RATE FROM CANCER IN CITIES AND RURAL DISTRICTS OF THE REGISTRATION STATES OF 1900, FOR YEARS 1900–1915.

Year.	Population.		Deaths from Cancer.		Death Rate per 100,000 Population.	
	Cities.	Rural Districts.	Cities.	Rural Districts.	Cities.	Rural. Districts.
1900	10,690,666	9,304,546	7,060	5,709	66.0	61.4
1901	11,105,137	9,303,729	7,717	5,721	69.5	61.5
1902	11,519,608	9,302,912	7,844	5,809	68.1	62.4
1903	11,934,080	9,302,094	8,498	6,152	71.2	66.1
1904	12,348,553	9,301,276	8,892	6,355	72.0	68.3
1905	12,763,026	9,300,458	9,323	6,660	73.0	71.6
1906	13,177,499	9,299,640	10,065	6,361	76.4	68.4
1907	13,591,972	9,298,822	10,544	6,780	77.6	72.9
1908	14,006,445	9,298,004	10,809	7,087	77.2	76.2
1909	14,420,918	9,297,186	11,530	7,300	80.0	78.5
1910	14,838,879	9,292,880	12,302	7,722	82.9	83.1
1911	15,202,813	9,342,600	12,760	7,836	83.9	83.9
1912	15,565,218	9,393,849	13,437	8,014	86.3	85.3
1913	15,927,982	9,444,739	14,042	8,455	88.2	89.5
1914	16,294,421	9,491,955	14,546	8,421	89.3	88.7
1915	16,662,676	9,537,356	15,208	8,853	91.3	92.8

(a) Data kindly furnished the writer in manuscript by the Bureau of the Census.

TABLE XXIX. (a)

DEATH RATES FROM CANCER IN CERTAIN EUROPEAN COUNTRIES CLASSIFIED BY CITY AND REST OF COUNTRY.

Year.	Population.		Deaths from Cancer.		Death Rates from Cancer per 100,000 Population.	
	Urban.	Rest of Country.	Urban.	Rest of Country.	Urban.	Rest of Country.
			ENGLAND AND WALES. (b)			
1881	5,058,823	20,987,319	2,898	10,644	57.3	50.7
1891	5,546,621	23,539,198	4,217	15,900	76.0	67.5
1901	6,141,048	26,471,086	5,553	21,934	90.4	82.9
1909	6,222,293	29,205,379	6,687	27,366	107.5	93.7
			SCOTLAND. (c)			
1881	740,890	3,001,674	424	1,490	57.2	49.6
1891	829,394	3,206,851	584	2,119	70.4	66.1
1901	1,092,515	3,386,550	864	2,798	79.1	82.6
1909	1,102,996	3,604,862	1,213	3,569	110.0	99.0

(a) Data from *Hoffman*, supplemented by material from *Falkenburg* and *March*.
(b) Cities are Birmingham, Bradford, Derby, Liverpool and London.
(c) Cities are Edinburg and Glasgow.

NORWAY. (d)

1881	120,722	1,793,278	105	769	87.0	42.9
1891	153,887	1,842,113	147	1,077	95.5	58.5
1901	228,336	2,006,664	222	1,904	97.2	94.9
1909	239,704	2,098,296	239	1,987	99.7	94.7

NETHERLANDS. (e)

1881	683,889	3,403,445	475	1,878	69.5	55.2
1891	890,776	3,702,379	743	2,905	83.4	78.5
1901	1,193,689	4,023,554	1,104	3,790	92.5	94.2
1909	1,366,862	4,453,613	1,385	4,627	101.3	103.9

AUSTRIA. (f)

1881	976,535	21,232,465	1,162	8,202	119.0	38.6
1891	1,683,096	22,312,904	2,018	11,009	119.9	49.3
1901	2,065,344	24,113,412	2,462	16,692	119.2	69.2
1908	2,416,104	25,427,421	3,207	18,973	132.7	74.6

(d) City is Christian.
(e) Cities are Amsterdam, the Hague, Rotterdam and Utrecht.
(f) Cities are Prague and Vienna.

TABLE XXX. (a)

DEATH RATES FROM CANCER, CLASSIFIED BY COLOR OF DECEDENT, IN THE REGISTRATION STATES OF 1910, FOR THE YEARS 1910–1915.

Year.	Population.	Deaths from Cancer.	Death Rate from Cancer per 100,000 Population.
	TOTAL.		
1910	47,807,766	36,364	76.1
1911	48,756,771	37,269	76.4
1912	49,595,220	39,279	79.2
1913	50,493,332	41,430	82.1
1914	51,455,677	42,706	83.0
1915	52,357,716	44,440	84.9
	WHITE.		
1910	46,425,660	35,638	76.8
1911	47,344,587	36,432	77.0
1912	48,153,883	38,424	79.8
1913	49,025,379	40,490	82.6
1914	49,941,006	41,716	83.5
1915	50,845,959	43,400	85.4
	COLORED.		
1910	1,382,106	726	52.6
1911	1,412,184	837	59.3
1912	1,441,337	855	59.3
1913	1,467,953	940	64.0
1914	1,514,671	990	65.4
1915	1,511,757	1,040	68 8

(a) Figures for 1910–1913 from a manuscript table kindly furnished the writer by the Bureau of the Census.

TABLE XXXI. (a)

DEATH RATES FROM CANCER CLASSIFIED BY SEX AND AGE, AND RATE OF DECENNIAL INCREASE, REGISTRATION STATES OF 1900, FOR 1900 AND 1910.

Age.	Males.			Females.		
	Death Rate from Cancer per 100,000 Population.		Rate of Increase 1900–1910.	Death Rate from Cancer per 100,000 Population.		Rate of Increase 1900–1910.
	1900.	1910.		1900.	1910.	
25–34	9.1	9.5	4	18.9	21.9	16
35–44	28.1	33.0	17	78.8	88.9	13
45–54	83.5	106.7	28	196.6	230.7	17
55–64	189.3	272.0	44	330.5	411.3	24
65–74	377.4	493.6	31	461.6	616.2	33
75+	516.9	693.7	34	609.1	867.8	42

(a) From a manuscript table kindly furnished the writer by the Bureau of the Census.

TABLE XXXII. (a)

DEATH RATES FROM CANCER PER 100,000 POPULATION CLASSIFIED BY SEX AND AGE, MASSACHUSETTS, 1860–1910.

Age Period.	1860.	1870.	1880.	1890.	1900.	1910.
			MALES.			
30–39	6.6	6.9	11.9	7.1	16.9	17.9
40–49	20.4	27.5	39.0	29.3	62.5	61.4
50–59	63.4	83.4	99.7	118.2	145.6	161.6
60–69	105.7	154.2	168.7	267.1	277.6	415.9
70–79	166.6	267.2	408.3	332.8	497.1	658.4
80+	349.7	354.8	491.1	331.7	655.4	955.1
			FEMALES.			
30–39	17.1	23.0	46.3	45.5	38.1	48.5
40–49	79.5	84.8	116.0	138.2	149.2	160.5
50–59	145.2	139.7	219.4	261.8	284.5	317.9
60–69	162.0	216.9	282.7	387.6	451.4	558.5
70–79	202.5	254.8	371.9	527.3	555.2	817.7
80+	341.4	379.4	320.2	438.2	680.1	861.4

PER CENT. OF DECENNIAL INCREASE IN DEATH RATE.

Age Period.	1860–1870.	1870–1880.	1880–1890.	1890–1900.	1900–1910.
			MALES.		
30–39	4.5	72.5	−40.3 (b)	138.0	5.9
40–49	4.2	41.8	−24.9 (b)	113.3	−1.8 (b)
50–59	31.5	19.5	18.6	23.2	11.0
60–69	45.9	9.4	58.3	3.9	49.8
70–79	60.4	52.8	−18.5 (b)	49.4	32.5
80+	1.5	38.4	−32.5 (b)	97.6	45.7
			FEMALES.		
30–39	34.5	101.3	−1.7 (b)	−16.3 (b)	27.3
40–49	6.7	36.8	19.1	8.0	7.6
50–59	−3.8 (b)	57.1	19.3	8.7	11.7
60–69	33.9	30.3	37.1	16.5	23.7
70–79	25.8	46.0	41.8	5.3	47.3
80+	11.1	−15.6 (b)	36.8	55.2	26.7

(a) Population figures used in computing these rates are those of the Federal censuses; deaths, those in the successive *Massachusetts Registration Reports.*
(b) Decrease.

TABLE XXXIII. (a)

DEATH RATE FROM APPENDICITIS IN THE REGISTRATION STATES OF 1900, FOR THE YEARS 1900–1915.

Year.	Population.	Deaths from Appendicitis.	Death Rate per 100,000 Population.
1900	19,995,212	1,763	8.8
1901	20,408,866	1,794	8.8
1902	20,822,520	1,825	8.8
1903	21,236,174	2,031	9.6
1904	21,649,829	2,224	10.3
1905	22,063,484	2,256	10.2
1906	22,477,139	2,318	10.3
1907	22,890,794	2,326	10.2
1908	23,304,449	2,396	10.3
1909	23,718,104	2,550	10.8
1910	24,131,759	2,685	11.1
1911	24,545,413	2,783	11.3
1912	24,959,067	2,743	11.0
1913	25,372,721	2,940	11.6
1914	25,786,376	3,149	12.2
1915	26,200,032	3,221	12.3

(a) Data kindly furnished the writer in manuscript by the Bureau of the Census.

SPECIAL MEETING OF THE AMERICAN STATISTICAL ASSOCIATION.

About 50 members and guests attended a special meeting and dinner of the Association held at the Aldine Club, New York City, Friday evening, April 20, 1917. Prof. Allyn A. Young, President of the Association, presided. The subject of the meeting was the value, especially to business interests, of federal census statistics, and possible improvements for the next decennial census in 1920. Prof. Robert E. Chaddock, Assistant Secretary of the Association, arranged the very interesting program.

The discussion was opened by W. A. Hathaway* of the American Telephone and Telegraph Company, who first briefly sketched the growth of the census from 1790 (the first census) to the present time, and then suggested several improvements in both scope and methods. In speaking of the next census, he discussed the desirability of: (1) keeping politics out of the census work, (2) certain changes in the schedules and classifications for manufactures, (3) a greatly simplified schedule for agriculture, (4) earlier publication of results, especially "Preliminary" totals, and (5) certain *annual* statistics of agriculture and manufactures, particularly the latter.

Various aspects of the census schedules and publications were then briefly discussed by the following speakers:

Colonel George Pope (National Association of Manufacturers)—emphasized the great value of census statistics to manufacturers, and pointed out the possible advantages of greater detail in industry classifications, and the desirability of collecting statistics at more frequent intervals.

O. P. Austin (National City Bank)—quoted census figures to show the need of annual censuses of agriculture and manufactures.†

* Mr. Hathaway was Chief of the Division for Agriculture and Chief Clerk of the Bureau during the 13th U. S. Census, 1910. (Editor's note.)

† His paper is printed in full elsewhere in this issue.

Osmund Phillips (Times Analist)—suggested that: (1) the effect of higher prices on the increase in value of products of manufactures be stated, (2) the hours of labor required to produce the products reported for each industry be shown, (3) a classification of the size (value of products) of establishments by ownership be added, (4) the per capita consumption be computed by industries, and (5) the number of persons employed and value of products be secured each month or quarter from 1,000, or so, representative manufacturers, and these totals be used as a current index of industrial conditions.

E. A. Goldenweiser (Office of Farm Management of United States Department of Agriculture)—stated that the Department of Agriculture was coöperating with the census in drafting the agricultural schedule for 1920. He distributed copies of a tentative schedule for criticism.

M. C. Rorty (American Telephone and Telegraph Company)—made some very interesting observations on statistics of incomes, with especial reference to the possibility of securing trustworthy data without a complete enumeration.*

Frank Green (Bradstreets Commercial Agency)—called attention to the fact that distribution (wholesale and retail trade) was about the only line of business and industry not now covered by a federal census, and suggested that the government might well consider extending its statistical activity to cover this field. He pointed out some of the many ways in which such data could be used to supply the missing link in the statistical chain, and make it possible to correlate much unrelated data.

F. H. Kenny (World Almanac)—expressed great appreciation of the service that census statistics were rendering to all classes of business interests. He strengthened the arguments in favor of annual censuses by stating that the majority of requests which he received were for *later* figures.

G. H. Van Buren (Metropolitan Life Ins. Co.)—reported that the American Public Health Association was now studying the population schedules with a view to making suggestions for the next census.

* His paper is printed in full elsewhere in this issue.

The President called upon Dr. R. P. Falkner* (Alexander Hamilton Institute) and Dr. J. A. Hill (Bureau of the Census) to close the discussion. Dr. Falkner elaborated on some of Mr. Rorty's observations on income statistics, and commented on several aspects of census work. Dr. Hill expressed appreciation, on behalf of the census, of the friendly suggestions and criticisms put forth by the several speakers. He said the census officials welcomed this sort of help and coöperation, and expressed the belief that much good would result from the discussion of the evening.

* Former Assistant Director of the Census.

SHOULD WE HAVE AN ANNUAL CENSUS OF AGRICULTURE AND MANUFACTURES?*

By O. P. Austin,
Statistician, The National City Bank of New York.

The question should we have a more frequent census of agriculture and agricultural products should unquestionably, in my opinion, be answered in the affirmative. Whether the more explicit question, should we have an *annual* census of agriculture should be answered in the affirmative there might be a difference of opinion. At present we have a decennial census of population, mining, and forestry, and a quinquennial census of manufactures, and it seems to me that nobody can doubt the advisability of having a census of agriculture even more frequently than that of manufactures, while the ideal plan would of course be an annual census for agriculture since a large proportion of the agricultural productions to be enumerated are annual in their recurrence.

And there are special reasons just at this time for feeling that agriculture is entitled to very close attention statistically as well as otherwise. We have reached a stage in our agricultural production in which scientific farming is of the utmost importance. We who, until within a comparatively recent time, were looked upon as the world's great purveyor of foodstuffs and manufacturing material have suddenly found that we have little of foodstuffs to spare for the outside world, and that we are ourselves consuming an increasing percentage of our manufacturing material. In the decade ending with 1900 we exported 36 per cent. of our wheat, but from that time exports declined, and in the 13 years from 1900 to the beginning of the war, we exported but 19 per cent. of our product, and in several years but 12 per cent. With the pressing demands of the war, however, the share of our products exported immediately increased and for the entire war period is about 29 per cent. of the total product. This increase in the percentage of our crop exported has, however, been at the

*Address delivered before the American Statistical Association at the Aldine Club, New York, April 20, 1917.

expense of our consumers, as is seen in the unprecedentedly high prices which now prevail, and the public anxiety as to sufficiency of supply pending arrival of the new crop. It is thus especially important, now that our population has reached a point at which it consumes most of our agricultural supplies, to intensify the product wherever possible, and to require our farms to supply as large a production per acre as do the much older lands of Europe where the production per acre averages about double that with us. To do this we should have all the information possible thereon, and this should include much more frequent official records of production than we have at the present time.

I use this term "records of production" because I want to distinguish between our present *decennial record* of production and the *annual estimate* of production supplied by the Department of Agriculture. In doing so I desire to make it perfectly clear that my suggestions are not intended as in any sense a criticism of or reflection upon the methods of the Department of Agriculture. That department, in fact, is performing a valuable service in its estimates and statistics of production, which it issues annually in certain lines, and from month to month during the crop year. But the facilities with which it operates and is compelled under present conditions to operate, and the limited appropriations which it has for performing that service cannot compare with those of a census, nor can anybody expect that the results will equal those of a census with a large corps of salaried enumerators covering the entire country in much greater detail than is possible by the Department of Agriculture under its present system of estimates by voluntary reports. In proof of this assertion it is only necessary to compare the methods of the two organizations of the Department of Agriculture, and the Census Bureau as stated by those respective organizations.

In the latest issue of the Monthly Crop Report, published by the Department of Agriculture, I find a detailed statement of the method by which the department collects the material upon which it bases its crop reports and estimates. Whether or not this statement was published at this particular moment with the purpose of supplying definite information for this

particular occasion, it at least does come to us at an opportune moment. It says:

The crop reports of the Department of Agriculture are not based upon actual enumeration of the total acreage planted of the different crops throughout the country, but are estimates, the accuracy of which rests upon the assumption that the average crop conditions existing at 50,000 separate points including every agricultural county of the United States, will be substantially the same as the conditions for all of the land under cultivation in this country. In other words, the government reports rest upon the scientific basis of the law of average. Therefore it is not necessary that voluntary crop reporters should report for an absolute area, rather it is important that they should give figures for that section only with which they are personally familiar by their personal observations and conversations with dependable neighbors. If each reporter will report accurately for his own neighborhood, the average for the state cannot fail to be almost absolutely correct. While the township is the ideal unit for reporting, these township reporters should not feel bound to report for the entire area embraced in the township, because experience shows that on the average the conditions existing in that part of the township under his immediate observation will faithfully reflect the condition over the entire township. County reporters are expected to report for the county as a whole upon practically the same principle, their reports being based upon their personal observations, reinforced by reports to them from different portions of the county. The average obtained from the reports from different sources, township reporters, county reporters, state field agents, and special lists of reports, are usually in exceedingly close agreement, and for important crops rarely varying more than 5 between the highest and the lowest figure.

Here we have a definite statement from the Department of Agriculture of the method by which it prepares the estimates of crop and other conditions, and it is only fair in considering this question of whether we should have more frequent census reports of agriculture to contrast the system of the Department of Agriculture with that of the Census Bureau. To do this I quote to you from the 1910 Report of the Census of Agriculture, the method by which its statistics were compiled. First, the law providing for the census of agriculture required that schedules relating to agriculture should include the name of the occupant of each farm, and among other requirements,

the value of live stock, the acreage of crops planted during the year of the enumeration, and the quantity and value of crops and other farm products in the year next preceding the enumeration. Each census supervisor was directed to employ suitable persons as enumerators who were respectively required to "visit personally each dwelling house in his division and each family therein, and by inquiry made of the head of each family, or of the member thereof deemed most competent and most trustworthy, obtain each and every item of information required by this act, and in case no person shall be found at the usual place of abode of such family competent to answer the inquiries, then the enumerator shall obtain the required information as nearly as may be practicable from families or persons living in the neighborhood of such place of abode."

It will be seen from this extract from the law that enumerators carry a uniform schedule to *every farm in the United States*, and obtain from the occupant of the farm, or if this is not possible, from others best equipped to supply the information, the data upon which the census report of production was made. The Department of Agriculture statement just read to you states that its estimates are based upon the opinion of 50,000 voluntary reporters. The census states that 5,795,000 farmers reported upon the schedules placed before them by the census enumerators, and while it seems reasonable to assume that the judgment of 50,000 Department of Agriculture reporters was good, it would appear that the judgment of the 5,795,000 farmers who actually produced the grain and live stock reported upon would be materially better in shaping up measurements or estimates of production.

That there is a marked discrepancy between the Department of Agriculture estimates, and the census count, will be evident from a comparison of a few of the statements of these two organizations relating to production in census years. In 1879 the Department of Agriculture figures as published by the Statistical Abstract of the United States, estimated the corn crop of the country 181,000,000 bushels below the census count for that year. In 1899 its wheat figures were 112,000,000 bushels below those of the census, and those of corn were 588,000,000 lower than those of the census. In 1909 its corn

figures were 220,000,000 bushels higher than those of the census, and its wheat figures, 54,000,000 above the census record. In the estimates of live stock there were greater discrepancies, supposed to be due in some degree to the fact that the census figures related to a different period of the year than those of the department, and included many young animals not in existence at the date of the department estimate as of January 1. The Agricultural Department, however, seems, after years of wide differences in the two reports to have concluded to give closer recognition to the census figures for in its published estimates of farm animals the figures of 1901, the year following the census of 1900 show a sudden and enormous increase, and are accompanied by a statement that "in estimates of 1901 and subsequent years due weight has been given to the figures of the census." The "weight" given to the census figures must have been very appreciable, since its estimates of cattle in 1901 are 42 per cent. greater than those of 1900, sheep 44 increase, swine 53, mules 37, and horses 22 per cent. greater in the 1901 figures than those of 1900, while the estimated value of all farm animals in 1901 was 36 per cent. greater than for 1900. By 1910, however, the department estimates seemed to have again required readjustment, for its 1911 figures showed a sudden increase of 39 per cent. in the estimated number of swine as compared with the year immediately preceding, while the group "oxen and other cattle" showed a reduction of 16 per cent. And all of these great changes it must be remembered occurred in the year immediately following that in which the census figures became available.

I am not making these comparisons with the purpose of criticising the figures of the Department of Agriculture, to which we are all under obligations for the results of the system by which it obtains with much greater frequency than the census the individual opinions of such a large force of observers in every part of the country, a service in which it produces prompt and valuable results, but I am only attempting to emphasize the fact that Congress is neglecting a duty to the great agricultural as well as economic interests of the country in omitting to require its great counting machine,

the Census Bureau, to apply from year to year to this most important of our industries the systematic and detailed study which it now applies only once in ten years.

Our manufacturing industry is at this time also very much in need of an additional service from the Census Bureau. For many years the decennial census of manufactures served a fairly satisfactory purpose, but with the rapid increase in manufacturing in the United States, and the equally rapid growth in the exportation of manufactures, there came a time when a more frequent census of manufactures was demanded by those engaged in that industry, whether as relates to capital, management, or employment. As a consequence, we have had since 1900 quinquennial censuses of manufactures, whereas prior to 1900 they were but decennial. And the time has now come, in my opinion, when the censuses of manufactures should be even more frequent. Down to 1900 the natural products, foodstuffs, and manufacturing material formed about two thirds of our exports, which had only just crossed the $1,000,000,000 line. As we entered the twentieth century there came a sharp change in the character of our exports; foodstuffs fell off amazingly, so that they formed in the year before the war only 18 per cent. of the total against 40 per cent. in 1900 and 56 per cent. in 1880. Conversely, manufactures, which formed in 1880 but 15 per cent. of the total exports were in 1900 35 per cent. and in 1913 practically 50 per cent. while since the beginning of the war, they have formed a much larger proportion, being 66 per cent. in 1916. It is perfectly apparent that we shall have in future, when conditions after the war return to normal, very little of foodstuffs to spare to the outside world, and that we are ourselves consuming an increasing proportion of the one class of manufacturing material which we have to sell, namely, cotton. All of this means that our future reliance for the growth of our exports must be manufactures. They have grown in the export trade, including in this figure finished manufactures and those for further use in manufacturing, from $180,000,000 in 1890 to $485,000,000 in 1900, $767,000,000 in 1910, and $1,185,000,000 in 1913, while with the abnormal demands of the world upon us, they grew to over $3,500,000,000 in the calendar year 1916, having

thus been in the calendar year 1916 more than three times as much as in the fiscal year 1913.

This growth in exportation of manufactures from $180,000,000 in 1890 to $1,185,000,000 in 1913 was normal, and while the enormous growth from 1913 to the end of the calendar year 1916 was of course abnormal, it does illustrate the possibilities of our manufacturers in producing for foreign markets, and suggests that they may be able in the future to assume the responsibility of maintaining the rate of growth in our total exports which occurred chiefly in foodstuffs during the earlier period in our history. And have we not good reason to believe from the lessons of the last three years that our manufactures are capable of assuming this new responsibility of increasing their share in the growth of our export trade? Without a very rapid growth in exports of manufactures our rank as an exporting nation must decline. And it seems to me that we may properly assume that a manufacturing industry which could under normal conditions increase its exports from $180,000,000 in 1890 to $1,185,000,000 in 1913, and follow this with the enormous increase which we have witnessed during the war period, may be relied upon to assume the responsibility for a continuation of the growth of our entire exporting trade despite the fact that exports of foodstuffs must decline in the immediate future.

To enable the manufacturing industries to assume this new duty, we owe it to them, in my opinion, to give them much more frequent official information regarding the manufacturing activities of the entire country. Each recurring census shows to each manufacturer of the entire country the amount of capital invested, the number of workmen employed, the amount of material purchased, and the value of output in the line or lines of industry in which he is individually engaged. That this information must be of great value to every manufacturer in broad studies of the development of the manufacturing industry, and especially his own particular line, goes without saying, and if such information is valuable to him when it comes on decennial or quinquennial occasions, how much more valuable would it be if he could have it annually?

I do not mean by this that we should take an annual census

of manufactures in the very great detail in which the quinquennial census is now made, but for a limited number of lines, those which form the large proportion of the output of our great manufacturing industry, an annual census could be taken at a comparatively small cost, and if in selecting these industries special attention were given to those in which we desire to increase our sales abroad it would prove of very great service to our export trade and to our manufacturing industry as a whole.

INCOME STATISTICS.*

By M. C. Rorty.

In these troubled days, when almost every element of governmental policy, and even the fate of whole peoples, hinges upon the completeness and reliability of statistics, it is not necessary to argue the practical value that may lie in knowing the basic facts in regard to our national economy.

The question is not whether we shall have statistics, but how the statistics that the inexorable logic of events has forced, and will force, us to set up may be made most accurate and most pertinent to our national purposes.

Income statistics have their immediate use in determining and controlling state and federal policies in respect to income taxes. Such taxation, in one form or another, is apparently with us to stay, and the needs of the taxing authorities are, in themselves, sufficient justification for a thorough analysis of the facts.

This need, while the most obvious, is not, however, the most important. Opinions may differ widely as to the ultimate outcome of the present world upheaval, but skilled observers are almost unanimous in predicting radical internal changes of a semi-socialistic type in the nations most directly involved. Such changes can hardly fail to be reflected by a period of political unrest and political experimenting in our own country, and this experimenting, directly or indirectly, must center, in the end, around that ever present and greatest of problems —the family income.

It is idle to ask whether the average voter may be trusted to give sane answers to questions of government ownership, of land nationalization, of labor legislation, of social insurance, and many others that will arise. The sufficient answer is that he must be trusted, since he has the power and the will to decide.

The second and greatest purpose of income statistics is, therefore, to furnish a sound basis for popular consideration of social and political problems.

* Paper read before the American Statistical Association at New York, April 20, 1917.

From the standpoint of taxation, the special requirement is for knowledge of the upper range of incomes, including those subject to proposed as well as present taxes. Within this range, which may be assumed to extend from $1,000 or $1,500 per annum upward, it is rather obvious that no census return, for any given individual, is apt to be more accurate than a sworn statement filed with and checked by the Collector of Internal Revenue. This being the case, the next problem is to determine how far below the range of actual taxation it may be desirable to extend the requirement for sworn returns, as a check against omissions and to provide advance indications as to the results that might be obtained from any proposed lowering of the limits of exemption. The answer will depend, to a considerable extent, on the general information that is available as to the lower range of incomes and the difficulties that are experienced in reconciling the income tax returns with such general data in the range of overlap.

A practical solution at this time might be to require returns from all persons having incomes within, say, $500 of the lower limit of exemption, and to require returns to be filed, in addition, regardless of income, by all heads of families and others occupying living quarters renting for, or having a rental value of, more than a specified amount. The latter provision would very considerably simplify the checking of the total number of returns filed, and would be in line with common knowledge that 10 per cent. or more of the average family income is paid in rent or its equivalent.

With these or other similar modifications of the existing laws in effect, the only remaining problem, from a statistical standpoint, would be that of determining the analysis that should be given to the returns as received. This matter is now being studied by a joint committee of this Association and the American Economic Association, in coöperation with the Commissioner of Internal Revenue, and there is every reason to believe that, within the limits fixed by permissible expense for tabulation, a very satisfactory analysis of income tax returns will soon be available.

Considering next the use of income statistics as the basis for popular and legislative consideration of social and political

questions, an entirely different statistical viewpoint is required. The problem in this respect is almost as largely one of publicity and education as it is of economic data.

The average worker today, as the most superficial inquiry will show, has a conviction, deeper and more firmly seated than his theology, that, if justice were done, he would receive at least two or three times his present wage. This conviction is also largely, if not so intensely, shared by educated and professional men of all classes; and the most curious feature of the whole situation is that, while each employer can prove that he, personally, is not a party to such injustice, a large part of employers themselves firmly believe that "big business," or the "money trust," or the "system" is at fault, and that they, as well as their employees, are being systematically robbed through some hidden kink in the general scheme of things.

It is this prevalent sense of a great social injustice that today offers the most fertile field for the efforts of the extremist and the I. W. W. agitator, and that a true and widespread knowledge of income distribution will have its greatest value in tempering to a point where sounder and more constructive counsels may be heard.

The differences between popular impressions and the real facts are, however, so great that the immediate need is not for an extreme elaboration of census procedure or for extreme exactitude of statistical results, but rather for breadth, impartiality, and comprehensiveness of viewpoint, and flexibility of approach. It is much more important, from the standpoint of the major uses of national statistics, that they shall tell a complete, coherent, and essentially truthful story of our national life, than that they shall be 100 per cent. exact in all details.

It is this point of view, among others, that led to the adoption, by the Chamber of Commerce of the United States, at its recent annual meeting, of resolutions in favor of the appointment of a Federal Statistical Commission to correlate and weld into a coherent whole the unrelated, although otherwise excellent, statistical work of the several federal departments, bureaus, and commissions.

Should such a commission be appointed, I have no doubt that it would assume, as a part of its task, the setting up, through the proper federal departments, of statistics covering the whole range of individual and family incomes, rather than the taxable range alone; and these statistics might properly be supplemented by a distribution of the total of such incomes according to basic sources,—wages and other returns for personal service, land rents, interest, and profits* in excess of a normal interest rate.

Such an analysis would have a practical value that will be appreciated at once by the members of this Association, and, in time, should be quite as fully appreciated by all those less technically trained who are interested in an orderly national evolution.

In approaching this analysis, I must differ, however, with Dr. King and others who would apply strict census methods throughout. My impression is that the final accuracy of results will be greater, and the expense much less, if census methods, as to certain basic elements in the determinations, are supplemented by skilled sampling processes for the establishment of related figures. For example, as to the element of land rents, the use of existing figures as to assessed valuations, in combination with skilled local estimates of the relation of site rents to such valuations, should give much more accurate results than could be obtained by any direct process.

Similarly, as to profits and interest charges in trade and industry, direct census methods might give much less exact results, even as to actual investment, than would be obtained by applying properly determined constants to basic figures as to average annual sales or output, number of employees, etc., for each class of establishments. Profits, in particular, vary so widely from year to year that only studies covering long periods, such as those recently made public by J. E. Sterrett, may safely be used, and the application of such long term

*In making this distribution, care should be taken to avoid combining "profits" and the "entrepreneur's wage." Profits should be defined as the excess of capital return over a normal interest rate, or, perhaps, over the average capital return in the marginal, or price fixing, group of establishments. The entrepreneur's wage should be treated simply as one class of returns for personal service. This distinction is particularly necessary in order to avoid giving false impressions as to social possibilities through profit sharing with employees, and might be carried a step further by making a distinction between profits of corporations and profits of individual entrepreneurs.

percentages to properly classified investment values might give more accurate general results than could be obtained by summing a great mass of individual returns in which the errors might readily be cumulative rather than compensatory. In this connection, it is especially important to note the vital distinction between interest and profits distributed in cash to individuals, and profits accumulated in a growing business or paid to other corporations. It is only interest and profits distributed in cash to individuals that become income of individuals. Undistributed profits may ultimately increase the volume of distributed profits and the total of individual incomes, but very frequently they become lost through the accidents of business before distribution is possible.

Considerations similar to the preceding hold true of the lower range of family incomes. Streightoff has suggested that the closest approximation as to city dwellers might be obtained through a census of actual and equivalent family rents. Such studies are privately made on an extensive scale as the basis for certain classes of engineering work and their practicability has been fully demonstrated. The range and distribution of family incomes associated with any given house rent undoubtedly varies in different communities, but the combined expense of a house rent census and the required special determinations should be very much less than that involved in any direct investigation; and the final results should be much less subject to systematic and cumulative errors. Figures as to house rents already at hand indicate that, within certain easily established classes of cities, there is so great a uniformity of distribution of families, in relation to either the median or the average rent, that it approaches an absolute law.

A further source of information as to individual incomes lies in the payrolls of the larger employers. These indicate, of course, earned incomes only, and cover only a fraction of the population, but I have reason to suspect that, under proper statistical analysis, they will reveal a law of distribution of such incomes, in relation to the average or median, that may be of great service in checking other figures.

All of the preceding are, of course, nothing but rough suggestions as to sources and methods. They may serve, how-

ever, to emphasize the fact that, for the broader uses of national income statistics, the first and most essential thing to have is what an eminent British statistician has aptly described as a "Central Statistical Thinking Office," and not a mere expansion and elaboration of uncorrelated statistical effort.

With this intelligent planning of our national statistical program we will need, also, an intelligent publicity, to which your own organization may contribute not a little.

A speaker at one of your dinners said, not long ago, that he had no interest at all in statistics, but was forever hunting for *the* statistic that had the punch and would carry conviction.

Let me conclude by giving rough illustrations of this point out of my own very sketchy study of income statistics.

First, as to earned incomes, large payrolls show that, if the excess of all salaries above $5,000 per annum were distributed among those getting less than $5,000 per annum, the average increase in pay in the lower range would be only 3 cents per day, and this increase would be only 11 cents per day if the limit were fixed at $1,500 per annum. War conditions may have shifted these figures somewhat, but cannot have changed the essential fact that no appreciable gain to the average worker can result from any conceivable evening up of earned incomes. An interesting side light on this point is that the average worker may doubt the propriety of some of the higher earned incomes, but, if questioned as to the relative industrial values of different classes of workers in the lower range, will very commonly indicate a greater spread in such values than is reflected in the average payroll.

Second, as to urban house rents, the average rent in typical large cities is only 20 per cent. or, say, $3.50 per month, higher than the median rent, and, if all sums now paid in excess of 150 per cent. of the average rent were distributed among families in the lower rental range, they could increase their present payments by less than 20 per cent.

Third, as to profits in trade and industry, the average real investment per employee is probably under rather than over $3,000, with book profits and interest charges of perhaps 14 per cent., and an actual cash distribution of perhaps 10 per cent. The excess of 4 per cent. above a normal 6 per cent.

interest rate corresponds to not more than $120 per annum, or somewhat less than 40 cents per day per employee.

These may sound like "stand pat" arguments, but they are indicative of facts which conservatives and radicals alike must face. It is reasonably clear, in any case, that the problem of a more equitable distribution of individual incomes, whatever that problem may be, lies in the unearned rather than the earned element, and is closely associated with the concentration of income producing wealth.

REVIEWS AND NOTES.

Social Diagnosis. By Mary E. Richmond, Charity Organization Department, Russell Sage Foundation, New York, 1917, pp. 511.

Statistics of social difficulties and of social needs are conditioned by the technique of social diagnosis. Social statistics are dependent upon social diagnosis in much the same way that public health statistics are primarily affected by the methods and terminology of physical and other forms of medical diagnosis.

Miss Richmond in her book outlines the processes which led to social diagnosis. These are, first, the collection and careful scrutiny of evidence rising out of the social worker's relations with his client, with the client's family, and with sources of information outside the family group; and second, the reflective comparison and interpretation of the evidence from these sources. The older and narrower process of "investigation" in social case work, with its loose technique and its besetting sin of almost exclusive emphasis upon the *gathering* of evidence to the detriment of essential matters of comparison and interpretation, is properly subordinated in this book.

The author considers first the nature and uses of social evidence as a basis for diagnosis. She outlines the logical tests for meeting in a practical manner the "enormous difficulty of making sure that the facts are as stated to us by others . . . and of avoiding that 'instinctive theorizing' whence the fact looks to the eye as the eye likes the look." The practicing social statistician will appreciate to the full the urgency of recording as exact a definition as possible of a given social situation and of its proximate and remote relations and causes. There is a commendably thorough discussion of the definitions bearing upon social evidence, of the terms most frequently used, and of the types of evidence, *i. e.*, whether real evidence, testimonial evidence, or circumstantial social evidence. Each of these types of evidence is examined in close detail. Testimonial evidence is especially well developed. A concluding chapter discusses inferences from the data collected, the risks involved in drawing conclusions from the facts at hand and from the social worker's particular state of mind.

The second section of the book discusses the detailed processes leading to diagnosis, and includes very extended technical comment on the scope and method of the interview with the client, with members of the family group, consultation of outside sources of information, the sources and validity of medical, legal and other records. A concluding chapter of the second part of the work defines the principles of criticism and comparison of the collected material, and the statement of a diagnosis.

Statisticians reading Miss Richmond's book, will recall the difficulties and limitations encountered by such pioneers as Amos Griswold Warner, Frederick H. Wines, and John Koren in the collection of social statistics in America. So many of these difficulties arose from the lack of any uniformity of methods of collecting and recording the basic data. One of the

effects upon American social statistics which should follow the introduction of works such as Miss Richmond has made available for social workers, should be the marked improvement of charity organization and other philanthropic agency records. Improvement of the statement of social difficulties upon the case records should result in better composite pictures of the social situation through the agency of the statistical method.

There is already a noteworthy precedent in the statistical study of social case work and of its results in the recently published report of the municipal court of Philadelphia for 1915. The methods employed by Dr. Louise Stevens Bryant in the compilation of these records for Philadelphia, if employed in studying the data which will undoubtedly result from employing Miss Richmond's criteria of social diagnosis, should provide for the first time in America the kind of social statistics which Professor Warner and the social workers and statisticians who followed him have defined as necessary for a critical analysis and an impartial survey of practical philanthropy.

New York City. E. W. KOPF.

Appendix A. Vol. I. Census of the Commonwealth of Australia. The mathematical theory of population, of its character and fluctuations, and of the factors which influence them, being an examination of the general scheme of statistical representation, with deductions of necessary formulae; the whole being applied to the data of the Australian census of 1911, and to the elucidation of Australian population statistics generally. By G. H. Knibbs, C.M.G., F.S.S., F.R.A.S., etc., commonwealth statistician. Published under instructions from the Minister of State for Home and Territories, Melbourne.

It is rare that a government census publication takes the form of this latest volume by Mr. Knibbs. As a rule census offices are so busy, collecting material, tabulating it, and getting out a brief analysis accompanied by a few charts, that they have no time to enter upon a scientific discussion of the uses which may be made of the volume. This is really a treatise on population statistics making use of the Australian figures primarily. In many cases the statistics of other countries are introduced for purposes of comparison. The first six chapters, covering about 85 pages, are devoted to a discussion of the formulas which may be used in determining the fluctuations and probable future course of populations. Then follows an interesting chapter upon graphics and the methods employed to smooth curves. After this, a discussion of population by sex and age, of natality, marriage rate, fecundity, mortality, and migration follows. An immense amount of work has gone into the preparation of this volume and the chart work is extremely clever and interesting. One would search long to find a better piece of analytical work than this. The census office of Australia is to be congratulated upon publishing such a volume and Mr. Knibbs deserves our thanks in showing the quality of work which can be done by its census office in addition to the details of collecting and compiling the basic figures.

Yale University. WM. B. BAILEY.

REED ON THE COEFFICIENT OF CORRELATION.

Since the development of the modern higher statistical methods has been largely in the service of biology, it is only natural that those who adopt the biometrician's formulae without a first hand acquaintance with the extensive biological literature should often labor under the disadvantage of using methods of calculation which are not the best suited to the practical needs of their work. If the methods adopted really give accurate constants, the use of more laborious routine processes is merely the misfortune of the individual worker. When, however, the beginner attempts, as is surprisingly often the case, to elucidate the subject for others, real harm may result, particularly when cumbersome and laborious methods are proposed in cases in which simple and direct formulae are already available.

A case in point is afforded by a recent paper by Reed.*

(1) The arithmetical routine indicated by Reed for the determination of the correlation coefficient by the summation of actual deviations, squares of deviations, and products of the deviations of the two variables from their respective means is wholly unsuited for practical work. All of the labor involved in the calculation of the five columns of his Table I is quite unnecessary. The elimination of this superfluous routine not only saves time but minimizes the danger of error which is particularly great when signs must be constantly regarded. The moments may be taken in terms of units about any point whatever. In these days of splendid calculating machines permitting simultaneous multiplication and summation, deviation methods involving positive and negative signs are inferior to one in which the first and second powers and the products of the two variables are summed, either directly from unclassified data or from the entries in a conventional correlation table. The formulae† required are:

$$\bar{x} = \Sigma(x)/N \qquad \bar{y} = \Sigma(y)/N$$

$$\sigma_x = \sqrt{\Sigma(x^2)/N - [\Sigma(x)/N]^2} \qquad \sigma_y = \sqrt{\Sigma(y^2)/N - [\Sigma(y)/N]^2}$$

$$r_{xy} = \frac{\Sigma(xy)/N - \bar{x}\bar{y}}{\sigma_x \sigma_y}$$

where x and y are the actual measures of the two variables, not their deviation from their mean value, the bars denote means and the sigmas standard deviations for the whole population of N individuals.

By the direct summation method Reed's Table I gives:

For July Rainfall, x, in inches:

$$\Sigma(x) = 243.9 \qquad \Sigma(x)/N = 4.065$$

$$\Sigma(x^2) = 1103.87 \qquad \Sigma(x^2)/N = 18.3978$$

$$\sigma_x = \sqrt{\Sigma(x^2)/N - [\Sigma(x)/N]^2} = 1.3687$$

*Reed, W. G. The Coefficient of Correlation. Quart. Pub. Amer. Stat. Asso., Vol. 15, pp. 670–684, 1917.

†Harris, J. Arthur. The Arithmetic of the Product Moment Method of Calculating the Coefficient of Correlation, Amer. Nat., Vol. 44, pp. 693–699, 1910.

For yield of corn in bushels, y,

$$\Sigma(y) = 2067.1 \qquad \Sigma(y)/N = 34.45$$
$$\Sigma(y^2) = 72446.69 \qquad \Sigma(y^2)/N = 1207.445$$
$$\sigma_y = 4.531$$

For rainfall and yield

$$\Sigma(xy) = 8612.99, \Sigma(xy)/N = 143.5498$$
$$r_{xy} = \frac{\Sigma(xy)/N - \bar{x}\bar{y}}{\sigma_x \sigma_y} = .565 \pm .059.$$

Reed gives $r = .526 \pm .063$, a value which is slightly erroneous because of the approximations necessary in the cumbersome method of calculation employed.

Full details concerning the application of this method to correlation tables, for both integral and graduated variates, are given in the paper cited.

(2) Reed lays entirely too great emphasis upon the necessity for a preliminary testing of linearity of regression and his discussion of the methods is very misleading. He says: "The correlations should never be attempted without first investigating the relationship far enough to see if it follows a straight line."

Now while it is true that the correlation coefficient is not strictly valid except in cases of linear regression it always gives at least a minimum measure of the relationship between two variables, and in the vast majority of cases this measure will be the one finally adopted after linearity has been tested.

Furthermore, the determination of the coefficient of correlation *is the first step in the critical testing of linearity.* It is quite unnecessary to plot the two variables in units of their standard deviation or to use the method of least squares in adjusting the line as suggested by Reed. When the correlation coefficient is known the straight lines are simply:

$$x = (\bar{x} - r_{xy}\frac{\sigma_x}{\sigma_y}\bar{y}) + r_{xy}\frac{\sigma_x}{\sigma_y}y,$$

$$y = (\bar{y} - r_{xy}\frac{\sigma_y}{\sigma_x}\bar{x}) + r_{xy}\frac{\sigma_y}{\sigma_x}x.$$

These can be calculated without even tabulating the raw data. Thus the equation from Reed's Table I is

$$y = 26.849 + 1.870\,x,$$

where y = yield in bushels and x = July rainfall in inches. This equation shows at once that the line in Reed's Diagram 2 on page 673 is incorrect. It should indicate an average yield of 30.59 bushels for 2 inches and 41.8 for 8 inches of July rainfall.

When the correlation coefficient and the regression equation have been determined, linearity may be tested by inspection of the distribution of the actual frequencies represented on a scatter diagram like Figure 2 or 3 of

Reed's paper, by a comparison of the empirical means of arrays with the theoretical means calculated from the regression equations, or by the use of Blakeman's criterion.*

Thus the calculation of the correlation coefficient, which by a practical method is a very easy task, should always be the first step in the analysis of the data. The nature of the regression line can then be determined in a convenient and really scientific manner.

(3) The bibliography given by Reed as "containing complete statements of the later development of work on the theory of correlation" is far from complete. A partial list of the omissions may be found elsewhere.†

This note is written with no desire to criticize the work of an individual writer, but merely in the hope of saving some beginner, who might follow Reed's suggestions, excessive and unnecessary labor in the calculation of the correlation coefficient, or misconceptions concerning the value or applicability of this most important statistical constant.

Cold Spring Harbor, N. Y. J. Arthur Harris.

COMMENT ON PROFESSOR IRVING FISHER'S ARTICLE ON THE "RATIO CHART."

The following remarks upon Professor Fisher's article in the *Quarterly Publications* for June are made without controversial intent and published rather as supplementary to than as critical of the statements made in the article in question. Where there is entire agreement, however, there is naturally little occasion for comment.

In the matter of terminology I do disagree with Professor Fisher, but that is hardly worth debating. The choice of the name "ratio chart," and the suggested opposition between "ratio" and "difference," is open to objection. Are not the curves in question currently and correctly known as logarithmic? Is it worth while to avoid this term simply because it, or the conception involved, is not familiar to the man in the street? All statisticians are acquainted with such curves, though many, it is true, feel them to be alien, just as some of them feel all graphic devices to be alien to their work. Should not the re-naming of a thing to make it popular be left to the commercial classes as a suitable mercantile, rather than a scientific or properly pedagogic, device? But, if the change means an improvement in our terminology, as regards either accuracy or adequacy, the case is different.

According to the usage with which I am familiar, statistical curves, and the diagrams constituted by them, are either arithmetic or logarithmic. Numbers and quantities are absolute or relative. Differences, also, may be absolute or relative. A relative difference is a species of ratio, and the

*Blakeman, J. On Tests for Linearity of Regression in Frequency Distributions. Biometrika, Vol. 4, pp. 332-350. 1905.

†Harris, J. Arthur. An Outline of Current Progress in the Theory of Correlation and Contingency. Amer. Nat., Vol. 50, pp. 53-64, 1916.

relative difference that is most familiar, both as regards species and form, is the per cent. increase. But the ratio may as well be to a constant as to a changing base—the latter being the case of per cent. increases. Index numbers are a familiar example of a system of relative numbers where the ratio is to a constant base. In a general way arithmetical curves and absolute numbers are thought of as corresponding to each other, the latter being the graphic expression of the former. This is not quite true, though there is no particular harm in such an association of ideas, provided it be accepted merely as such. Index numbers are relative numbers, but a series of such numbers, as directly plotted, constitutes an arithmetical curve. But a more thoroughly *relative* graphic expression of quantity and quantitative relations is found in logarithmic curves. I am informed by a mathematician to whom I have referred this paragraph that my use of terms here is in conformity with current mathematical usage.

The idea of the "ratio chart" as developed by Professor Fisher appears to correspond to that of relative numbers or rather, specifically, to per cent. increases. Such relative increases are so important in statistical analysis that a correlative graphic device properly claims an important place in statistical practice. It is true in a general way that logarithmic curves correspond to per cent. increases. The objection to an equation of the two is that per cents., though so serviceable, are fundamentally a clumsy and often misleading kind of relative number, while the logarithmic curve is a thorough and even elegant method of expressing quantitative relations where relative, rather than absolute, numbers are of fundamental significance—which is doubtless the more usual case in statistics. It is not a part of Professor Fisher's task to point out the limitations of per cent. comparisons, but the omission is significant if the reader gains the impression that the logarithmic curve is a translation of per-cent.-increase ratios into graphic terms. Relatively speaking, a 20 per cent. increase is not twice a 10 per cent. increase, and a 50 per cent. increase is not the equivalent of a 50 per cent. decrease. The defectiveness of the method of compiling index numbers formerly in use and recently abandoned by the United States Bureau of Labor Statistics was due to ignoring such facts. An increase of 20 per cent. in 10 years is not an average increase of 2 per cent. per year. These objections do not apply to the *logarithmic* expression of numerical relations. The peculiarity of the logarithmic curve—and of course the difficulty of understanding it—appears greater after considering these illustrative examples. But it should also be evident that this graphic and statistical device is much more worth mastering than it would be if it were merely the counterpart of numerical per cent. analysis. A true feeling for the significance of logarithmic curves is to be obtained only by studying and using them. But they are worth the trouble, and the limitations of per cent. analysis are the best proof of their worth.

Professor Fisher has passed rather too cursorily over a type of arithmetical curve in which the absolute numbers are not plotted directly, but instead per cent. indices. Per cent. indices are the quotients (with the decimal point moved two places to the right) of the absolute numbers,

resulting from division by some constant, the average being frequently the most convenient divisor. The writer is in the habit of calling such curves per-cent.-index curves. It should be noted that they use *relative* numbers. But the difference of such relative numbers from the absolute series is merely the difference between the foot and the meter—or whatever other arbitrary standard of length happens to be most convenient at the time being for purposes of plotting and comparison. The only difference between such a curve and a plot of the absolute numbers is in the scale, the preliminary computation serving chiefly the purpose of adjusting and controlling the scale, especially in a way to put two or more series of numbers upon an entirely comparable basis. Obviously such curves are to be interpreted like other arithmetical curves, though the adjustment of the scale is such as to make it usually convenient to refer the variations to a 100 per cent. axis instead of to a zero base, this feature justifying the cutting-off of the lower portion of the diagram and the utilization of the available space to better advantage, as may be done with logarithmic curves. Curves plotted from series of per-cent.-indices, it should be noted, are already adjusted so as to be grouped at the center of the diagram, at least if the 100 per cent. point for each series is the average of the series. Thus the per-cent.-index method has many of the advantages of the logarithmic method.

But the logarithmic curve is unquestionably a superior order of graphic device, and the fact that it is not generally familiar and understood is rather occasion for calling attention to its value—of course making the necessary explanation of how it works and why it is used—than for avoiding it where it is really most appropriate. That it is not always most appropriate may be illustrated by the fact that comparative logarithmic curves of the growth of population in France and Germany in the last hundred years would not meet the needs of the dominant interest in such a comparison. The per-cent.-index curve probably serves better to express the variation of an electrical load around its average than does a logarithmic curve, since the kilowatt capacity required at the peak should not, for most purposes, be represented as less important, or as occupying a less length on the vertical scale, than the kilowatt required during the hours of light loading.

That the use and qualities of logarithmic and per-cent.-index curves are subjects of thought not new to the writer may be shown by the following references to the annual reports of the New York Public Service Commission for the First District, where such curves, accompanied by more or less comment, will be found.* Logarithmic curves: Vol. III for 1908, p. 296ff; III for 1910, p. 24ff and p. 40ff;† III for 1911, p. 57ff; III for 1912, p. 78ff; II for 1913 p. 82ff.† Per-cent.-index curves: Vol. III for 1913, p. 71ff; III for 1914, p. 59ff and 72ff; II for 1915, p. 195ff.‡

New York City. G. P. WATKINS.

*From 1911 on the graphic work and a large share in the analysis is by Mr. L. H. Lubarsky.

†Here both the vertical and the horizontal scales are logarithmic.

‡This diagram has other special features, but the per-cent.-index device is fundamental.

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Prepared by Library Committee: Roger W. Babson, Edmund E. Day, Henry J. Harris.

Quarter Ending March 31, 1917.

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SOME RECENT FRENCH STATISTICS ON INFANT MORTALITY.

At the outbreak of the war, effort looking toward protection of infant life in France was systematized by an official orgnization, namely, the Central Office of Maternal and Infantile Assistance. The purpose of this endeavor was "to secure to every pregnant woman and to every mother caring for a child under three years of age, suitable social, legal, and medical protection; to see to it that no woman should be forgotten and that no infant should remain unnoticed."

The effects of the numerous difficult war conditions on infant life were noted almost from the very beginning of hostilities. Dr. Adolphe Pinard, an obstetrician of the University of Paris, has condemned in toto the employment of pregnant women in industrial establishments, but his official confrères have not been able to adopt his extremely radical views. How

ever, the statistics which are responsible for these views are unimpeachable, although some of Pinard's colleagues of the *Academie de Medicine* allow themselves to be less alarmed than he. Pinard's figures, taken from the *Bulletin hebdomodaire de statistique municipale*, cover three years,—August 1, 1913–August 1, 1914, August 1, 1914–August 1, 1915, and August 1, 1915–August 1, 1916. Following is a brief review of the statistical material:

TOTAL NUMBER OF LIVE BIRTHS RECORDED AT PARIS.

August 1, 1913–August 1, 1914	48,917
August 1, 1914–August 1, 1915	37,085
August 1, 1915–August 1, 1916	26,179

Of the above the number of mothers concerned who receive public aid is thus indicated:

	Aid Given at Home.		Institutional Aid.	
	Number.	Per Cent.	Number.	Per Cent.
August 1, 1913–August 1, 1914	6,540	13.26	31,912	65.24
August 1, 1914–August 1, 1915	7,253	19.54	27,341	73.74
August 1, 1915–August 1, 1916	5,790	22.10	19,139	73.10

It will be noted that in the year August 1, 1915–August 1, 1916, 95.2 per cent. of all live births were assisted by public benefit. In the first year of the war, 2,491 women were delivered without public aid; in the second year, 1,250 women.

The tables quoted by Pinard for the three years mentioned fully discuss total live births, stillbirths, the number of infants handed over to nurses outside Paris, and infants abandoned by their mothers. Tables showing in detail infant mortality for 0 days—1 year, 1 year—2 years, and 0 days—2 years, and figures covering maternal puerperal mortality and causes, duration of pregnancy, and weight of newborn infants are also included in the paper; all of these refer respectively to the three years.

	Stillbirths. (Per Cent.)	Infants Placed Outside Paris. (Per Cent.)
August 1, 1913–August 1, 1914	7.69	31.00
August 1, 1914–August 1, 1915	6.63	13.35
August 1, 1915–August 1, 1916	7.57	22.32

	Infants Abandoned by Their Mothers.	Maternal Puerperal Deaths.
August 1, 1913–August 1, 1914	4.98	0.67
August 1, 1914–August 1, 1915	2.86	0.46
August 1, 1915–August 1, 1916	5.21	0.48

INFANT MORTALITY.

	0 days—3 mos. (Per Cent.)	0 days—1 yr. (Per Cent.)	1 year—2 yrs. (Per Cent.)	0 days—2 yrs. (Per Cent.)
August 1, 1913–August 1, 1914	8.10	15.51	4.33	19.86
August 1, 1914–August 1, 1915	7.41	15.20	5.12	20.36
August 1, 1915–August 1, 1916	7.40	15.00	5.50	20.48

Causes named are 10, namely, diarrhea and enteritis, congenital debility, respiratory affections, unknown or obscure diseases, tuberculosis, simple meningitis, measles, whooping-cough, scarlet fever, and diphtheria.

The result of Pinard's paper was to precipitate discussion in the Academy, considerable divergence of view being brought out. A committee was therefore appointed to study the subject and make suitable recommendations to the Academy. After debate on the measures advocated by a majority of the committee, the Academy modified the committee's resolutions which, somewhat amended, were finally adopted.

A committee of the Academy was then appointed to report on the subject of depopulation in France. A table included in this report, recently rendered, shows that the number of live births in France declined in France from 1,011,362, in 1876, to 745,539, in 1913. Some of the years enumerated show gain over the years immediately preceding, but not enough to offset the downward zigzag. Figures are also given for Germany, England, Sweden and Austria. The committee, representing primarily the standpoint of the physiologist, hygienist, and physician, concluded that the decline in the birth-rate can be remedied; that it is not due to impairment of French virility but that it is largely voluntary; that a child constitutes an expense and that the question is chiefly economic. Eight measures to relieve the situation are proposed by the committee; discussion by the Academy of these recommendations is pending.

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